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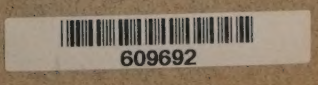
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REPORTS

FROM

COMMISSIONERS, INSPECTORS,

AND OTHERS:

THIRTY-FIVE VOLUMES.

— *(25.)* —

LOCAL GOVERNMENT BOARD—*continued.*

Session

12 *March* 1894——25 *August* 1894.

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FROM

COMMISSIONERS, INSPECTORS,

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THIRTY-FIVE VOLUMES:—CONTENTS OF THE

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THE LOCAL GOVERNMENT BOARD.

REPORTS AND PAPERS

ON

CHOLERA IN ENGLAND IN 1893;

WITH AN

INTRODUCTION

BY THE

MEDICAL OFFICER OF THE LOCAL GOVERNMENT BOARD.

Presented to both Houses of Parliament by Command of Her Majesty.

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PUBLIC HEALTH.

REPORTS AND PAPERS

ON

CHOLERA IN ENGLAND IN 1893.

SUBMITTED BY THE MEDICAL OFFICER

OF

THE LOCAL GOVERNMENT BOARD,

1894.

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REPORT.

TO THE RIGHT HONOURABLE THE PRESIDENT OF THE LOCAL GOVERNMENT BOARD.

SIR,

I BEG leave to submit to you, for presentation to Parliament, the following report on cholera in England during 1893.

In my last report, which dealt with the proceedings of your Medical Department during the year ending Lady Day, 1893, I gave an account of the European epidemic of cholera during the year 1892, and I reported that, although 35 cases of cholera had reached our shores between August 25th and October 18th of that year, the disease had in no case extended to any person beyond those arriving from abroad.

This result, eminently satisfactory in itself, was not one which, under the then existing circumstances of Europe, could well be expected to repeat itself if cholera broke out anew in the following year; and it was because of apprehensions of such recrudescence and of the strain to which our sanitary organisation, whether along our coast-line or inland, would thereby become subjected, that I urged upon the Board the institution of the Cholera Survey and that increase in the staff of the Medical Department to which I have already referred in my last report.

The risk to England, in regard of cholera during 1892, had been in one sense limited by the concurrent operation of two factors. In the first place the disease, having travelled step by step across the continent of Europe, only reached our shores somewhat late in the season at which cholera most readily becomes epidemic in this latitude. And secondly, the imported disease reached us direct from places, such as Hamburg, where it was in full vigour, and where the majority of persons who received the infection might be expected, on arrival in this country, to develop symptoms sufficiently typical of cholera to admit of the early recognition of the disease. But, in urging the adoption of special measures of precaution in anticipation of cholera in 1893, I took occasion to point out that if, with the advancing summer, recrudescences of the disease should take place in the ports and towns along the western littoral of the continent of Europe, we might have to face the risk of a series of importations extending over several months, instead of several weeks, of that period when cholera has, aforetime in England, tended to assume epidemic proportions. And not only so; I also expressed the opinion that if the cholera reached us in the early stages of any recrudescences in Western Europe, we should be exposed to the risk of the importation of mild attacks of the disease which it might be difficult to differentiate from attacks of that summer diarrhœa which is commonly prevalent with us year by year.

Cholera in England in 1893.

Happily there was not, in the spring and early summer of 1893, anything that can be regarded as an epidemic recrudescence of cholera in those places in western Europe where the disease had been prevalent in the summer and autumn of 1892. Even Hamburg, for the first time in the history of its epidemics, escaped a second year of cholera: a result that must, in the main, be attributed to the provision of new works of water supply for the city, works which were set up by immense labour and completed with a rapidity almost, if not altogether, unexampled. Cholera was, as a matter of fact, recognised in English ports and towns at a distinctly earlier date in 1893 than in the preceding year, but the number of such cases hardly exceeded a dozen before the end of August.

But if my surmise as to early importation of cholera into England in 1893 failed to be fully realised, the failure seems to have been more in appearance than in fact; since such importation was in all probability obscured by reason of the occurrence of that second source of danger to which I had adverted, namely, the arrival of the disease in a phase when its true nature did not admit of early recognition. The story of cholera in the ports at the Humber mouth is, in truth, a story of cholera the first beginnings of which were clouded and obscured by attacks first regarded as diarrhœa, which was next looked upon with grave suspicion and called by such names as choleraic diarrhœa and cholera nostras, and was finally recognised to be true cholera.

The history of cholera in England in 1893 is embodied in a series of reports, which I submit in Appendix. The first is a general report on the cholera prevalence as a whole by Dr. Barry; then follow a number of reports on special occurrences of the disease which called for local investigation by the Board's Medical Inspectors; and the last contains an account of the bacteriological studies by Dr. Klein of certain material derived from individual cases of disease that was submitted to the Board for examination.

The first definite importation of cholera into England in 1893 took place in the Tyne port, where a vessel hailing from Nantes arrived on June 25th with the body of a man who had died a few hours before from that disease. No further importation was recognised until July 18th, when the Cardiff Port Authority found it necessary to isolate two convalescing cases which had arrived by ship from Marseilles. Two days after, a case of cholera reached the port of London in a vessel from Marseilles and Havre; the actual nature of the attack being confirmed as the result of bacteriological examination by Dr. Macfadyen; and on the 24th of July a vessel from St. Petersburg, which had touched at Dieppe, brought two men into Liverpool port whom it was found necessary to remove to hospital on account

of symptoms of cholera. These, with one secondary case, making a total of seven, were all the attacks known of in England up to the end of July; they were all brought from abroad into our port districts; and it is worthy of record that in these cases, and, indeed, as regards 11 out of the total of 13 cases in which cholera was detected in our port towns during 1893, no extension of the disease to any person other than those who had arrived from abroad took place.

Dr. Barry's report (Appendix A., No. 1) gives a summary account of disease reputed to be of the nature of cholera which took place in England in 1893. In all, 64 separate localities, of which 15 were metropolitan sanitary districts, were involved. Exclusive of the few ship-borne cases, the total number of attacks was 287, and of these 135 terminated fatally. But of the 64 localities referred to, there were no less than 42, including 14 metropolitan districts, in which only single attacks were heard of. In only one metropolitan district did the number of these reputed cholera attacks reach three; and taking England and Wales as a whole, there were only five localities in which the attacks exceeded 10 in number.

If Dr. Barry has erred, it has not been in the direction of understating the number of reputed cholera attacks in England; on the contrary, he may be regarded as having included some cases which might properly have been eliminated from his list. Indeed, the antecedent and clinical histories of some of the cases in question are such as, in themselves, to raise doubt whether the attacks were true cholera; and the great excess of instances in which a first case remained a solitary one, tends at first sight to emphasise that doubt. But on the other hand, it must be noted firstly, that, taking all the attacks together, the fatality rate reached 47 per cent.; secondly, that in 35 of the 42 single attacks death ensued; and thirdly, that in several of these isolated attacks material submitted for bacteriological examination to different experts gave positive evidences of true cholera. Indeed, I am of opinion that the circumstances attaching to these solitary attacks, as also to a number of others where two or three attacks followed each other in such rapid sequence as to amount in fact to a single manifestation of the disease, do credit, in the majority of cases, to our English system of public health administration. Where the case is the reverse, I shall not fail to indicate it.

As regards a number of cases which were made the subject of special investigation by one or other of the Board's Medical Inspectors, I would now make the following further remarks.

Local Manifestations of Cholera and Reputed Cholera.

Cholera at :— (*a.*) Great Grimsby and Cleethorpes.

The earliest indication of a cholera prevalence in England during 1893 took place in the town and port of Great Grimsby

and the adjoining sanitary district of Cleethorpe-with-Thrunscoe, both situated on the southern shore and near the mouth of the Humber. On August 21st, the Board were informed by the local Medical Officer of Health of these districts, that three deaths from "cholera nostras" had occurred between August 11th and 20th, it being added that in one of the cases the medical practitioner in attendance, who had certified the death as due to "cholera nostras," had referred to the symptoms as being those of Asiatic cholera. Towards the close of the month deaths registered as due to cholera nostras, choleraic diarrhœa, and diarrhœa, became more numerous in Grimsby, and Dr. Reece was instructed to visit the borough without delay. His report, which deals with both Great Grimsby and with Cleethorpe-with-Thrunscoe, commonly known as Cleethorpes, will be found in Appendix A., No. 2.

Directly the matter was investigated, it transpired that disease of a choleraic character had been prevalent and fatal in Grimsby ever since the beginning of the month of August. Thus, a man who had arrived in Grimsby port on August 2nd, on board the SS. "Dania," from Antwerp, and who had died the following day of "choleraic diarrhœa" in the Port Hospital Ship, had been buried with precautions—including the wrapping of the body in sheets soaked in carbolic acid, and the surrounding of the coffin with quicklime—such as are sufficient to indicate that grave suspicion was locally entertained as to the real nature of the disease in question. On August 11th, there was a fatal attack styled "cholera nostras" in the town itself, and by August 30th there had been no less than 15 deaths of a similar character, 14 of which had occurred in the town, There had also occurred a fatal attack, registered as due to "cholera nostras," on August 15th, in a suburb of Grimsby, but just within the jurisdiction of the Cleethorpes Urban Authority. But not until August 31st, two days after Dr. Reece's arrival in Grimsby, was the first certificate of death indicating the presence of true cholera issued. In Cleethorpes, where four more fatal attacks of "diarrhœa" or of "choleraic diarrhœa" took place between August 27th and September 2nd, the first death referred to "cholera" was so certified on the last-named date. Reviewing the circumstances in the light of subsequent knowledge, it appears that, in addition to the death of the man removed from the SS. "Dania," cholera caused, in Great Grimsby, 15 deaths in August, 18 deaths in September, and 2 in October; and that there were in Cleethorpes, 3 fatal attacks in August and 4 in September, making 43 deaths in all in these two adjacent places.

Directly it became evident that cholera was prevailing in Grimsby and Cleethorpes, the Board, acting under the powers conferred upon them by section 134 of the Public Health Act, 1875, issued an Order declaring certain epidemic regulations to be in force within these districts. This Order was issued on September 1st, 1893, and it was followed by a supplemental

Order on September 6th. Both these Orders are reproduced in Appendix A., No. 17. The regulations embodied in the Orders required the division of each of the urban sanitary districts into "sub-divisions," the appointment of medical visitors and assistants in each sub-division, the daily visitation of localities inhabited by the poorer classes, the gratuitous supply of medicines, medical aid, and nursing, the isolation in hospital or otherwise of the sick, the speedy burial of the dead, together with the adoption of measures of cleansing and disinfection wherever these were needed. Choleraic diarrhœa as well as cholera was, for the purposes of the regulations, declared to be a notifiable disease, and a daily record giving particulars as to cases of these maladies was ordered to be transmitted to the Board. These Orders remained in operation until January 8th, 1894.

The beginning of cholera in Grimsby and Cleethorpes is involved in considerable obscurity. With a view to its elucidation, Dr. Reece traced the antecedents of a number of persons by whom the disease might have been imported by sea during the first days of the month of August, but the materials collected failed to afford any satisfactory solution of the difficulty. When, however, notification of "diarrhœa" was instituted by the Grimsby and Cleethorpes Sanitary Authorities, it was found that this disease, under the designation of which certain fatal attacks, which must be regarded as cholera, were registered, had become very widely prevalent in both places. "Diarrhœa" was also causing a large mortality. Indeed, the diarrhœa death-rates of Grimsby and of Cleethorpes during the third quarter of 1893, were out of all proportion to those of the large towns and cities of England during the same period, and they very greatly exceeded the corresponding rates which had obtained in those districts in antecedent years. And when the details of fatal "diarrhœa" in Grimsby came to be examined more minutely, it further transpired that the excess of death registered under that heading had commenced about mid-July; that 29 fatal attacks had occurred in the four weeks ending August 5th; that in the next five weeks, during which cholera was most prevalent in the borough, no less than 81 deaths were ascribed to diarrhœa; and that taking the period August 5th to October 14th, during which period disease of the nature of cholera attacked 127 persons and caused 35 deaths in Grimsby, there were 89 fatal attacks assigned to "diarrhœa." Thus, prevalence of cholera both in Grimsby and in Cleethorpes occurred simultaneously with an epidemic prevalence of diarrhœa; and, in Grimsby at least, it was preceded by an ominous increase of mortality referred to that cause. This is but a repetition of that which has so often occurred before in the history of cholera; and it can hardly be doubted that cholera had made its way into Grimsby and Cleethorpes sometime before the fact was recognised, and that the disease secured a footing in those towns, for want of the adoption of adequate measures of prevention at an early stage. Such measures as were carried out during the month of August, came too late to prevent

the spread of an infection which had by that time had ample opportunity for diffusion. The true character of this early diarrhœa was later on significantly illustrated, when "infective diarrhœa" spread amongst the shipping in two of the docks in sequence to the occurrence of illness on board a vessel which was certified to be infected with "cholera."

In dealing with the local conditions which in Grimsby may have served to facilitate the spread of cholera when once introduced Dr. Reece is able to eliminate the public water service; but he attaches importance to the influence of the faulty conditions of sewerage and drainage. Indeed, in Grimsby one of the advantages usually claimed for the "water carriage" system, namely, that of the rapid removal of excreta from the proximity of dwellings, is to a large extent frustrated. This result is mainly due to a practice by which so-called "cesspools" are constructed along the line of the house drains, in such a way that solid filth and refuse are retained on or near domestic premises instead of being carried away to and by the sewers; and, incidentally, there ensue local nuisances from foul effluvia, and not unfrequently soakage of filth, including specific filth, into the superficial soil. Such conditions, when coupled with the damming back of sewage in the sewers by tidal action for a large part of each 24 hours, are precisely of a kind which have commonly been associated elsewhere with excessive prevalence of "filth disease"; and, apart from the cholera and diarrhœa already referred to, it is noteworthy that during the period July 29th to November 4th, 1893, no less than 260 cases of enteric fever, with 41 deaths, were recorded in Grimsby. The distribution in Grimsby of 127 attacks of cholera, choleraic diarrhœa, and cholera nostras, and of 326 cases of enteric fever during 1893, as also of 451 attacks of "diarrhœa" in the single week, September 6th–12th, is shown by Dr. Reece in a series of charts. The tendency of these three filth diseases to especially affect the same localities deserves the careful attention of the Local Sanitary Authority.

The Grimsby sewage is ultimately discharged by means of two outfalls, under circumstances which admit of its being washed back over oyster, mussel, and cockle beds. To this disposal of the sewage in connexion with the cultivation of shell fish, and its possible relation to the diffusion of cholera, I shall refer again.

(b.) Hull. On the 24th August a first case of cholera was recognised in Hull. This case, which terminated fatally, was clinically one of a very suspicious character; moreover, the materials examined gave unequivocal bacteriological indications of true cholera. The previous history of the patient, a boy of 11 years of age, afforded no actual proof as to the source of the infection; but it is known that he sickened 16 hours after swallowing some exceptionally foul water in which he was bathing, and that of six of his fellow bathers, no less than five suffered from nausea, or vomiting, or diarrhœa. The water in

question is known to have been befouled by sewage, and one sample of it revealed the presence of Koch's typical comma-bacillus. Having regard to these circumstances, and to the fact that this case was followed by 11 other fatal attacks of cholera during the month of September, much interest attached to the history of Hull in regard of cholera or choleraic diarrhœa, both antecedent to, and at the time of its first recognition in the borough; and this subject is dealt with in considerable detail in Dr. Theodore Thomson's Report (Appendix No. 3). By the aid of compulsory notification returns, of other and voluntary returns, and of death certificates, it was ascertained that Hull early in September passed through an exceptional prevalence of diarrhœa, some of the attacks being "choleraic"; that the diarrhœa death-rate for the borough during the third quarter of 1893, was greatly in excess of that for the large towns and cities of England, and nearly three times as great as the average decennial rate for Hull; that between September 2nd and October 11th, there were 152 attacks of "choleraic diarrhœa," of which five terminated fatally; and that the incidence of this choleraic diarrhœa was, unlike that of ordinary summer diarrhœa, essentially on persons coming within the age-group 15–60 years. It was also ascertained that in addition to diarrhœa antecedent to the 24th of August, one very suspicious attack, involving cramps, vomiting, and purging, had occurred in an adult on August 16th. The story of cholera in Hull is therefore complicated by a considerable prevalence of diarrhœal disease, much of which was of a highly suspicious nature; and is entirely consistent with the view that cholera had been introduced into the borough in a form in which it at first failed to be recognised. The persistence both of cholera and of choleraic diarrhœa in the borough can harly be dissociated from conditions involving the pollution both of soil and air; and it is noteworthy that the localities which suffered most from cholera and choleraic diarrhœa, are also those in which an exceptional excess of diarrhœa and of enteric fever were most marked. The sanitary circumstances of Hull evidently leave much to be desired; and had it not been for the exceptionally high standard at which the sanitary service of the borough is maintained, cholera would probably have found in those circumstances a means for a wider diffusion of its infection than was witnessed.

(*c.*) Rotherham.

The first recognised attack of cholera in Rotherham took place on September 5th: the patient died within 14 hours of his initial symptoms. No complete clinical record of the case was, under the circumstances, forthcoming, but bacteriologically the case was pronounced to be indistinguishable from true cholera. A second attack, also fatal, took place on September 11th, and this was followed by a third non-fatal attack on October 18th. These two later attacks were clinically regarded as due to true cholera; and with the first-named one they were the only cases which at the time were recognised and certified

as "cholera." But on September 10th, "diarrhœa" was added to the list of notifiable diseases in the borough, and several important points were elicited as the result of this action. First was the fact that 18 cases certified as "choleraic diarrhœa" took place between September 15th, on which day four such cases were notified as then existing, and October 18th. Secondly, in two of the cases of choleraic diarrhœa, which occurred early in October, and of which one was fatal, bacteriological examination of the intestinal discharges showed that these attacks were, like the first recognised case, indistinguishable from "cholera." Thirdly, the notification returns of diarrhœa also went to show that 402 attacks returned under that heading took place in the seven and a half weeks September 10th to October 31st; 150 being notified in the the first seven days and 86 in the second seven days of that period. Fourthly, the mortality returns showed that during both the second and third quarters of 1893 the death-rate from diarrhœa in Rotherham considerably exceeded the mean of previous years, that it was far higher than that of other large towns in England and Wales, and that in the third quarter it reached 6·74 per 1,000 living, whereas it hardly exceeded 3·5 in 100 "large towns" grouped together, and was only 2·8 in England and Wales as a whole. And lastly, when judged by the mortality returns, it was seen that diarrhœa was more prevalent in Rotherham both during July and August than it was in September, when cholera and choleraic diarrhœa were first recognised. But any significance which might otherwise attach to this excess of death from diarrhœa in Rotherham during the second and third quarters of 1893, can be thought of as largely discounted by the fact that the incidence of this mortality was, as in ordinary years, essentially on infants and old people. Indeed, no death from diarrhœa occurred over five years and under 60 years of age.

With regard to the causation of this choleraic outbreak, no satisfactory solution could be found. The water supply of the borough, to which I referred in my last annual report, remained open to contamination, and the soil on which the town lies was found to be exposed to fouling by soakage of filth, but neither these circumstances nor any others that were discoverable threw any light on the origin or subsequent distribution of the cholera or the choleraic diarrhœa in question. And, when the occurrence of disease of a like sort, antecedent to September, came to be investigated, nothing more definite could be discovered than the fact that a woman who with several friends had been at Grimsby and Cleethorpes on the preceding day, had rapidly succumbed to some undefined but fatal illness, associated with collapse, on August 24th. This woman alone, amongst the party of whom she formed one, had partaken of oysters on the sands at Cleethorpes. Dr. Theodore Thomson's Report on this outbreak will be found in Appendix A., No. 4.

(*d.*) Middleton.

On September 4th, a publican's widow, residing at Middleton, in Lancashire, who had had antecedent diarrhœa, was seized with a fatal attack which in many important respects, including profuse watery evacuations, sub-normal temperature, suppression of urine, and collapse, resembled cholera. She died in 14 hours, her death being certified as due to "choleraic diarrhœa." When the details of the case were subsequently investigated, nothing could be elicited to connect the attack with any former occurrence of cholera. Four persons were present during the preparation of this woman's body for burial, and within 32 hours of so doing, one of these, an aged woman, was seized with similar symptons and died in 12 hours. Her death, which took place on September 7th, was certified as due to "cholera." On the same day a third adult woman assisted in laying out the body of this old woman, and in emptying out a flock bed which had been saturated with her discharges. This third woman sickened next day. She suffered from symptoms such as profuse watery diarrhœa, vomiting, cramps, and sub-normal temperature, but she recovered. Her attack was notified as one of "cholera," but it was subsequently explained that it had been looked upon as a case of "English cholera." On these occurrences becoming known to the Board, Dr. Sweeting immediately visited Middleton, and he there ascertained that the group of cases referred to had been preceded by two others: one involving an attack of fatal "English cholera" in a woman on July 7th; and the second, a fatal attack, which set in on August 22nd. This latter case was that of a woman, who suffered from violent watery purging, cramps, and vomiting, and who fell into a lethargic state and died on August 27th. Her husband had previously suffered from severe diarrhœa. Dr. Sweeting only reached Middleton in time to see one of the patients, the one who recovered after sickening on September 8th; but, as he points out, an occurrence associated with symptoms such as those which he relates, and involving the death of four out of six adults attacked, has not hitherto been known in this country apart from true cholera infection. Such other sickness as was heard of in Middleton consisted of minor diarrhœal attacks simultaneously affecting relations and neighbours of certain of the deceased. In no case was bacteriological investigation resorted to. (Appendix A., No. 5.)

(*e.*) Westminster (London).

On September 7th, a fatal attack, certified as due to "choleraic diarrhœa—cholera," took place in the person of an adult female residing in the parish of St. Margaret and St. John, Westminster. The woman in question was employed as a "cleaner" in the House of Commons, and it was there that she was attacked with severe abdominal pain, vomiting, and profuse diarrhœa on September 5th. Returning to her home she suffered from frequent and copious rice-water stools, cramps, blueness of extremities, sunken eyes, livid complexion, sub-normal temperature, intense thirst, diminution—if not suppression—of urine,

and collapse, which terminated in death during the night of September 6th-7th, within 40 hours of the commencement of the attack. The clinical features of the disease were those of true cholera, and bacteriological investigation of the rice-water stools and of a piece of ileum, revealed in typical and pronounced form conditions which, according to Dr. Klein, were "absolutely typical of a pure case of Asiatic cholera." The principal interest of this case lay in the obscurity of its cause; indeed, the only point that seemed in any way to be related to the woman's illness, was the fact that she and her two daughters suffered from diarrhœa and abdominal pain on September 4th, after having eaten the remains of some pickled pork and rabbit which had been purchased two days before; but owing to the extremely retiring habits of the woman, her history immediately antecedent to her attack was involved in much doubt. Dr. Sweeting's report on the circumstances of the case, as also Dr. Copeman's account of the measures of cleansing and disinfection that were carried out in the House of Commons, are reproduced in Appendix A., Nos. 6 and 7.

(*f.*) Ashbourne (Derbyshire)

On September 6th, a localised but very severe and fatal outbreak of cholera commenced at Ashbourne, in Derbyshire. According to Dr. Bruce Low's Report (Appendix A., No. 8), the attacks were limited to a single yard behind the "Coach and Horses" Inn, where, out of a total of 39 inhabitants living in eight houses, there were in seven days no less than 15 cases of cholera, with nine deaths. The symptoms were typical of cholera; they included violent vomiting, profuse diarrhœa with "rice-water" stools, cramps, sub-normal temperature, more or less suppression of urine, collapse, and rapid death. In one of the fatal cases, bacteriological examination of a portion of the ileum gave positive indications that the disease was true cholera. The interest of the Ashbourne cholera story lies largely in the circumstances with which the outbreak was associated. The yard itself abounded in those conditions which are notorious as favouring pollution of air, soil, and water, by reason of emanations from and soakage of filth. The "Coach and Horses" received lodgers of a very low class, including hawkers and other nomadic folk, and Ashbourne "wakes," when many persons of the itinerant class visit the township, had only recently come to an end. Inside the inn, and situated against one of its outer walls, was a hand-flushed watercloset, having a broken soil-pipe; close by was an outside urinal, which also served on occasion as a closet, as also a gully which was at times made the receptacle of excreta. In immediate proximity to these was sunk the well which supplied the yard with water. The subsoil was porous; it was saturated with excreta, which had escaped through the defective soil-pipe of the "Coach and Horses" closet, to within 18 inches of the well; and it was fouled besides by reason of the filth from the urinal and the gully. The first recognised attack was that of the landlady

of the inn itself, and her discharges were so disposed of that they cannot but have reached the well, the water from which was found to be "teeming" with comma-bacilli. These, on further investigation, were found "morphologically and "culturally identical with those obtained from the discharges of "cholera patients." This woman's case was probably preceded by some unrecognised attack in one of the many wanderers who had recently frequented the inn. Of the eight households resorting to this well, six were invaded with cholera, and the further progress of the disease was only stayed by stopping the use of the well water, and by filling in the well with quicklime. This latter step was taken on September 12th; but before this, two severe attacks of "diarrhœa" in persons residing outside the precincts of, but close by, the "Coach and Horses" yard had occurred.

Ashbourne, lying near the Derbyshire Dales, is a place which is largely frequented by visitors, but its sanitary traditions are in some respects eminently unsatisfactory. When diphtheria was prevalent and unduly fatal there some six years ago, Dr. Bruce Low, in reporting to the Board on its sanitary circumstances, took occasion to condemn its water supply; and in dealing with the pollution of the shallower private wells by means of dung-heaps, pigstyes, and collections of animal filth, he pointedly referred to the pump in question as one sunk close by the "urinal attached to a public-house," whence there was soakage "through the unpaved and unprotected yard above the "shallow well."* On receipt of this report, which was communicated to the Authority, the Board urged upon that body that they should secure a supply of wholesome water adequate to the requirements of their district. The answer received stated, amongst other things, that the Local Board "consider "that the town is as well supplied with water as the majority of "other towns in the country." Thenceforward, evidence went on accumulating as to well pollution in Ashbourne and as to the need for a proper water service, and both the Medical Officer of Health for the district and the County Health Officer expressed themselves strongly in this sense. In view of the prospects of cholera, Ashbourne was chosen by the Board as one of the localities calling for special visit on account of its well known sanitary shortcomings. Hence in June 1893, before the appearance of cholera in England, Dr. Maclean Wilson was instructed to inspect the district. On this occasion he once more drew attention to the need for a water supply that should not be subject to the risk of pollution, and he recommended action without delay. He also made special comment as to the condition of the yards within the town. Following on this, a public notice was issued by the chairman of the Authority requesting householders and ratepayers to record their opinion

* Report by Dr. Bruce Low on Diphtheria in Ashbourne Urban Sanitary District, page 75 of Report by the Medical Officer of the Local Government Board for 1888 (C. 5812-1), 1889.

as to a scheme of water supply which had for some time past been in contemplation, and this notice at last admitted that the existing water was "both impure and insufficient." But when cholera invaded the place in September, Ashbourne still retained its polluted wells; and a section of the population was still actively opposing the new scheme for a public water service. Immediately following on the cholera outbreak, formal application was made by the Ashbourne Local Board of Health for sanction to a loan to provide a complete system of water supply, but the scheme had ultimately to be abandoned owing to legal difficulties. Preliminary action is now being taken with a view to an alternative supply.

This history of cholera in the "Coach and Horses" yard, at Ashbourne, recalls the worst we have ever known of cholera in this country. On a small scale it exemplifies, in September 1893, much as the history of Hamburg did on a large scale in 1892, how potent for mischief and for death is a water so circumstanced as to become specifically polluted by cholera discharges. It recalls the outbreak which, in 1854, was caused by water from the pump in Broad Street, Golden Square, and which Dr. Snow has made historic in the annals of English cholera; and it vividly reminds us that the words used more than 30 years ago by my predecessor, Sir John Simon, to the effect that "excre- "ment-sodden earth, excrement-reeking air, excrement-tainted "water, these are for us the causes of cholera," hold good now just as they did then.

(*g*.) Appleton-le-Street (*Malton R.S.D.*)

Another localised outbreak, which must be regarded as one of cholera, occurred in the village of Appleton-le-Street, in the Rural Sanitary District of Malton, Yorkshire. The circumstances which were investigated by Dr. Copeman (Appendix A., No. 9) were as follows:—

A small freeholder of intemperate habits, who had been staying a week at Scarborough, fell ill on his journey home on the night of September 6th. Having arrived at his house at Appleton-le-Street, he suffered from profuse diarrhœa, collapse, and severe cramps; he then became pulseless, with sunken eyes and blue lips, his limbs were icy cold to the touch and, after continuously passing watery evacuations of a milky appearance, he died early on September 10th. The sequel to this case ultimately brought the circumstances under the notice of the Medical Officer of Health, who communicated with the Board. A married sister of the dead man came from Terrington to Appleton, a distance of some six miles, to attend his funeral, and, after staying in her late brother's house for two days, was seized with diarrhœa and cramps. Her condition was critical for some days, but she ultimately recovered. The father of the dead man's widow also came from Terrington and attended the funeral on September 12th, and he returned to the house at Appleton again on the 18th. On the 19th he, too, was seized with profuse diarrhœa, vomiting, and cramps; the discharges were watery, with whitish

flocculi; and within four-and-twenty hours of his attack he sank and died on the 20th. The first patient's widow slept on the night of the 18th in the bed in which her husband had died, the bed clothes, which had been saturated with his discharges, having only been dried. Next day she was attacked with very similar symptoms; in her case the stools were of the typical "rice-water" character. She also died on the 20th, within 12 hours of her father. In this case microscopical and bacteriological examination of a portion of the lower intestine gave results which were typical of true cholera. A niece of this woman had not only been residing in the house at Appleton, but had shared with her the dead man's bed on the 18th of September, and this girl next sickened. Being a deaf-mute, no details of her case were procurable beyond the fact that after her return to Scarborough, on September 21st, she had sharp diarrhœa with pain about the body. She ultimately recovered. No illness could be heard of at either of the places from which those persons came who attended the first patient's funeral. The only circumstances they had in common were their stay in his house at Appleton and their rapid seizure with choleraic symptoms. Built on to the wall of the Appleton house and adjacent to the larder was the privy belonging to the dwelling, and this privy had received the owner's bowel discharges. The water supply, which was imperfectly protected against surface pollution, was found to be organically impure; but at the date when it was examined no proof could be obtained of its having become infected with the cholera organism. The history of the five attacks, of which three were fatal, pointed first to infection imported into Appleton, and then to its subsequent communication to all of the dead man's relations who had stayed in his house. In seeking some clue as to the cause of the first attack, it transpired that, with one exception, the food supplies which the six inmates of the house at Scarborough, in which the man in question had stayed, had been common to the whole household. The exception was that the man who had sickened on his way home to Appleton had partaken freely of oysters, which had almost certainly been derived from Cleethorpes. He alone had eaten oysters, and he was the only member of that household who suffered from any diarrhœal symptoms.

(*h.*) Morton and Owston Ferry. (*Gainsborough R.S.D.*)

On September 7th, an adult male, residing in the village of Morton, situated on the right bank of the Trent, in the Gainsborough Rural Sanitary District, was suddenly seized with symptoms identical with cholera. He died within 19 hours of his attack, and bacteriological examination of a portion of his ileum gave distinct indications of true cholera. A son of the man in question returned to Morton on August 31st with a halibut which he had purchased in the docks, at Hull, and the fish was eaten by the family, consisting in all of five adults, on the same evening. Next day the mother was attacked with diarrhœa, which lasted until September 5th; and on the morning

of the 7th, the father—who, as already stated, was fatally attacked that day—had taken part in emptying the midden-privy which had received the alvine dejections of his household, including those of his wife. In this work he was assisted by two of his sons, one of whom was attacked with diarrhœa onthe 10th. The son who had been in Hull had, so far as could be gathered, not suffered from any diarrhœa. But, having regard to the cholera which prevailed in Hull at this date, the fact that three diarrhœal attacks, of which the central one in point of time gave proof of being cholera, occurred in this family of five people, one of whom had recently arrived from Hull and had brought fish from that place, cannot be ignored in connexion with the disease which followed. But Dr. Bruce Low, whose report is appended (Appendix A., No. 10), shows that there had been antecedent attacks in this rural district. In the village of Owston Ferry, which lies some eight miles to the north of Morton, on the opposite bank of the Trent, and where "summer diarrhœa" is rare, there had been fifty or more attacks of "diarrhœa" and six fatal attacks of "choleraic diarrhœa" between July 31st and September 14th. So also in the little village of Susworth, somewhat lower down the river and on its right bank, there were cases of "choleraic diarrhœa" during September. The Trent, which is polluted with sewage, has for some time past been under suspicion by the Board as a source of water supply; but of the persons fatally attacked in Owston Ferry only two could be learned to have used this water. On the other hand, people in Owston Ferry have frequent and intimate communication with Hull, and Hull people come to Owston Ferry as visitors. One Hull visitor, arriving about mid-August, had diarrhœa several days after reaching the village. The sewerage arrangements of Owston Ferry are precisely such as would serve to spread disease associated with alvine discharges of a specific type.

(*i.*) Great Yarmouth.

A report by Dr. Copeman on a series of four cases of suspected cholera at Great Yarmouth will be found in Appendix A., No. 11. Only the last of these came under Dr. Copeman's personal observation; the history of the three previous attacks being elicited after their termination. The first case which aroused any suspicion on the part of the local sanitary officers occurred in the person of an adult itinerant who at the time had frequented a common lodging-house in the borough. The attack, which was reported to the Medical Officer of Health on September 8th, was one of severe diarrhœa with cramps, which, after removal to hospital, speedily ended in recovery. The case was notified as one of "English cholera," and at the date of Dr. Copeman's inquiry no evidence was forthcoming to show that the case had been of the Asiatic type. The second case occurred in the well-known "Rows," the patient being a middle-aged widow, who on September 18th was attacked with watery diarrhœa, vomiting, and cramps. Beyond these symptoms

none that were indicative of true cholera seem to have been observed, but the patient died suddenly on the morning of the 20th. On her burial, special precautions, such as are commonly observed in cases of cholera, were adopted. A third attack came under notice on September 22nd, the patient being a boy aged 13 years, residing in another part of the town. The boy had some trivial ailment on the 20th, but it was only on the 21st that diarrhœa set in, and he died the following day. Two circumstances are referred to by Dr. Copeman in connexion with this case. The first relates to the boy's habit of bathing in the river at a point where the water is fouled by sewage from a hospital and from certain dwellings. The second has to do with the sale, in Yarmouth, of cockles professedly coming from Lynn, but being in fact derived from Cleethorpes, and sent through Lynn in order to hide their place of origin. Close to the boy's home was a shell-fish shop which he is known to have frequented, but no evidence of his having actually purchased or eaten cockles was forthcoming. Bacteriological examination was made of a portion of this boy's ileum, which was transmitted for the purpose from Yarmouth to Dr. Klein (*see* Appendix B., page 182); and although no clinical history beyond that of diarrhœa, involving "suspicious-looking stools" and subsequent death, had been forthcoming, yet both microscopically and culturally the case was characteristic of cholera. Cultivations, indeed, in a number of media all revealed "pure crops of Koch's comma-bacillus."

The fourth attack commenced on the morning of September 28th, the patient being a girl nine years of age, residing with her parents and three other children in the Yarmouth "Rows." Vomiting, fluid evacuations of rice-water character, sub-normal temperature, sunken eyes, blueness of hands and lips, and corresponding collapse, were the early symptoms; from these she rallied in hospital, but death ensued within about eight days of the commencement of her illness. A rice-water stool, passed on the first day of attack, was found to consist of a colourless fluid in which were suspended flakes made up of epithelium; on bacteriological examination this stool was ascertained to be "a pure cultivation of Koch's cholera commas"; and the case was in other respects very typical of Asiatic cholera (*see* Appendix B., page 183). This attack was, like the others in Yarmouth, the only one which occurred in the house in question, and no definite history as to its cause could be made out. Close by was a shell-fish shop where children were supplied with cockles, and these cockles, like those previously referred to, came professedly from King's Lynn.

(*k.*) Ilkeston (Derbyshire).

At Ilkeston, in Derbyshire, there occurred about the middle of September four acute attacks of diarrhœal illness in adults which, taken together, were of a distinctly suspicious character. Three out of the four attacks terminated fatally, two of them within twelve and eighteen hours of their onset. The first

attack, in point of date, occurred in an adult male just convalescent from enteric fever; the symptoms were not those of enteric fever relapse, and death only occurred after eight days. Within six and nine days respectively of this man's initial symptoms, two of his sisters sickened. One lived with him, the other came daily to his house. Both had symptoms which resembled cholera; in one of them they were in several respects typical, and the patient died within twelve hours of her attack. In this case, microscopic and cultivation experiments with material derived from a portion of the ileum gave positive indications of cholera. Another case occurred in the person of a nightsoil scavenger. His attack took place about midway, in point of date, between the others; clinically it had much resemblance to cholera, and it rapidly terminated in death. This man's attack was not ascertained to be causally related to the others. There were faulty sanitary circumstances in connexion with each of the houses where these persons lived, but neither these nor any other circumstances, beyond the possibility of personal infection in the case of the two sisters, could be found by Dr. Wheaton, who visited Ilkeston, to account for the occurrences reported on. (*See* Appendix A., No. 12.)

(*l.*) Fulham (London).

On September 11th, an adult female, who was an inmate of the Fulham Workhouse, died after 20 hours' illness. Her death was certified to be due to "choleraic diarrhœa," but in notifying it the medical officer of the institution stated that he regarded the case as extremely suspicious in character. The patient rose as usually on the morning of the 10th, she had an attack of vomiting at 8.30 a.m., and a second attack soon after mid-day. Within little more than an hour of noon it was found that she had been seized with profuse vomiting and purging, which left her in an apparently insensible condition. Later on she became cold and blue, the temperature of the body was below 95° Fahr.; the purging and vomiting recurred, cramps set in, and after further very profuse purging, between midnight and 2 a.m. on the 11th, she died at 4.30 a.m. The bowel discharges in the later stage of the disease were reported to have resembled "water above, with soft white flakes below." The post-mortem appearances, which are described by Dr. Copeman (App. A., No. 13) and Dr. Klein (App. B., page 179) revealed, amongst other things, a deeply congested condition of the small intestine, which contained a fluid "like pea-soup," and a collapsed and empty urinary bladder. Microscopically, the intestinal contents exhibited numerous epithelial flakes crowded with bacteria, amongst which were a few comma-shaped organisms and numerous free flagella. Sub-cultures revealed pure crops of Koch's comma-bacillus, and in peptone culture the typical "cholera-red" reaction was well marked. The importance of this case lies in the following facts:—Clinically, pathologically, and culturally, the case was not to be distinguished from cholera of the Asiatic type; the patient had, for some two

years, not quitted the workhouse; she had not been known to have received any visitors from without; her food was that of the other inmates; all possible contact with infection, either direct or indirect, seemed to be excluded with a certainty that can rarely be attained; and the attack was apparently an isolated one.

(*m.*) North Bierley.

Between the close of the third week of September and the middle of the second week of October, there occurred in the Urban Sanitary District of North Bierley, in Yorkshire, a series of seven attacks of cholera. The attacks were generally of great severity, and in six out of the seven they terminated fatally. The first to be attacked was a youth who, after a stay at Southport, reached his home in North Bierley on the 18th of September. He was then suffering from diarrhœa. This diarrhœa would appear to have been maintained up to the 24th, when medical advice was sought. The youth was then found to be in a state of collapse, with cold extremities, sunken features, cramps, and sub-normal temperature; he was also vomiting and passing rice-water stools. At the end of three days there was some rally with febrile symptoms, but a condition of collapse returned and he died on October 3rd, the death being certified as due to "choleraic diarrhœa" with "collapse and exhaustion." The next to be attacked was this youth's mother, who was seized with typical symptoms of cholera at midday on September 26th. These symptoms included vomiting, diarrhœa, cramps, and sub-normal temperature. By 3 o'clock in the afternoon she had become profoundly collapsed, and she died at 11 p.m. on the same day. An adult sister of this woman took part in preparing her body for burial, and on the evening of the 28th she, too, was found to be in a state of collapse, and to be otherwise suffering from symptoms in every essential respect resembling those which had been followed by death in her sister. She died early in the morning of the next day, September 29th. The father of the youth was also attacked on the 28th; his symptoms being equally typical of cholera. After a slight rally, collapse again set in, and he died on October 1st. Another adult sister of the youth's mother had also taken a share in laying out the body of her relative. She was attacked with like symptoms on September 27th, and died on October 2nd. An aged woman, who was also related to this family, had not only visited the youth's mother in her illness, but had taken part in nursing the first of her two sisters during her illness on Septemher 28th and 29th. She was taken ill with diarrhœa on October 1st; on October 5th the diarrhœa rapidly became worse, vomiting and cramps set in, typical collapse supervened, and she died on October 9th. All the above six patients had been attacked, and five of them had died by October 3rd. The attacks were, unfortunately, regarded as being cases of "choleraic diarrhœa" and "English cholera," and it was only subsequent to the occurrence of the five deaths

that the Board received, on October 5th, the first intimation of the outbreak. Dr. Bulstrode was immediately instructed to visit North Bierley, and a piece of the dead youth's ileum was procured for bacteriological investigation. But the material had already assumed a gangrenous aspect, and what is, perhaps, more important, it was only secured late in the illness, and after the stage of re-action had supervened. Hence it is not astonishing that, although the microscopical appearances were extremely suspicious of cholera, confirmation of this suspicion, as the result of culture experiments, was not forthcoming. When, however, the sixth patient was taken ill, she was visited by Dr. Bulstrode, and some of her discharges were collected and despatched to Dr. Klein, with the result that Koch's comma-bacillus was found in them on microscopic examination, this demonstration being subsequently confirmed by means of cultivation. The seventh patient in this series began to suffer from diarrhœa on October 1st, and when visited medically on the 4th, was found to have vomiting and diarrhœa. She alone of this group of seven cases subsequently recovered, having at no time exhibited typical cholera discharges or collapse. This patient, an elderly woman who was a friend of the family, had also taken part in laying out the body of the youth's mother.

This limited outbreak of illness (Appendix A., No. 14) affords a story that is typical of Asiatic cholera. If it differs from occurrences of cholera as heretofore observed in this country, it only does so by reason of its extreme severity and fatality. It is also somewhat singular in the fact that, unlike most attacks of similar suddenness or virulence, the infection was not due to a contaminated water supply. Direct infection by reason of contact with an antecedent case seems to have been more than commonly potent for mischief; for with the exception of one girl, whose movements could not be traced, all who took any part in nursing the sick or in preparing the dead for burial were attacked with the disease, and only one escaped death. From the etiological point of view there is but one link missing in the story. Nearly three weeks had elapsed between the date when diarrhœa was first recorded in the youth who suffered from the initial attack, and Dr. Bulstrode's arrival in North Bierley; the patient in question had since the onset of his earliest symptoms been resident in two different counties; and both he and all but one of his near relations, from whom trustworthy information might have been forthcoming, had since died. Under these circumstances it is not to be wondered at that no conclusion could be come to as to the source whence the infection had been derived. In this connexion it should also be remembered that one or more cases of reputed cholera had, at the date of the onset of diarrhœa in the youth concerned, already manifested themselves in 47 different sanitary districts of England, including 12 localities in the two counties referred to.

(*n.*) Tividale (Rowley Regis U.S.D.).

Between the morning of September 23rd and that of September 25th, five adults and a boy of six years of age were seized with grave symptoms at Tividale, a colliery hamlet in the Rowley Regis Urban District. (Appendix A., No. 15.) Five out of the six attacks occurred in contiguous yards of the same street; the yards presenting conditions favourable to the pollution of both air and soil, and in one instance the water of the well was open to suspicion. The sixth attack occurred in a row where nearly every sanitary circumstance apart from water supply was grossly defective. The symptoms from which this group of patients suffered included severe and sudden vomiting with purging, cramps, at times intense, shrivelling and blueness of the skin, sunken eyes, and vox cholerica. Such motions as came under medical observation were, in the main, not such as are strictly regarded as of the "rice-water" type. Two of the six patients died within 24 hours of being attacked, and bacteriological examination of a portion of the intestine in one of these cases, an adult woman who died on September 25th, revealed evidence such as is associated with definite cholera. Dr. Sweeting reached Tividale on the 26th, but before this date there had been such disposal of the dejecta of the patients as might in itself have served to spread infection. On the 27th two other attacks occurred, one of the patients being the child of the woman who had died on the 25th, and the other an adult female who had been constantly in and out of the cottage where this death had occurred. The original cause of this occurence in Tividale was not discovered; and although in some cases there was at first suggestion as to the attacks being possibly related to the consumption of such articles as mussels, nothing confirmatory as to this could be made out. The simultaneity of the first attacks would seem to point to some common but undiscovered cause; perhaps this had to do with certain antecedent cases of diarrhœa, which had taken place in the very neighbourhood where the majority of the earlier attacks occurred.

(*o.*) Coton Hill Asylum (Staffordshire).

A report by Dr. Bulstrode (Appendix A., No. 16) deals with two diarrhœal attacks which occurred in the Coton Hill Asylum, near Stafford, on September 26th and 29th, and which, though lacking some of the clinical characters of true cholera, both terminated fatally with symptoms of collapse within less than 18 hours of the onset of the disease. The two patients in question occupied the same ward, but they alone, out of 136 patients and of the asylum staff, suffered from any malady at all suspicious of cholera. Inquiry, both within and without the asylum, failed to associate the attacks with any previous case or with any food supplies. But, on the occurrence of the second death a portion of the ileum was submitted to bacteriological investigation, with the result that both microscopically and culturally evidences indicative of true cholera were obtained.

General Considerations.

From the reports embodied in Appendix A., some of which I have already particularised, it will be evident that after the importation of a few isolated cases of cholera into certain English ports in June and July 1893, definite cholera prevalences set in at Grimsby and Hull during the month of August, and that following on this event a number of attacks, mostly isolated ones, occurred in different parts of England during the period August to October. The beginnings of cholera in both of the Humber port towns are involved in obscurity. Cholera was on several occasions imported into both these ports in August and September 1892, and it is, of course, just possible that the disease may at that date have made its way into the towns abutting on these ports in an unrecognised form, and that in this way the occurrences of 1893 may have been due to recrudescence of the infection, first in mere diarrhœal form, and then, as the disease progressed further into the autumnal season, as unmistakeable cholera. This view might well be regarded as finding some support from the fact that, prior to the recognition of cholera in both of the towns in question, there had occurred an exceptional prevalence and fatality from diarrhœal disease. But, on the other hand, cholera epidemics, whether in this or other countries, have again and again been associated with similar occurrences of antecedent diarrhœa; and this when the recrudescence of a former local infection could not possibly have been in question. Indeed, the story of cholera in the Humber towns last year is typical of that which might have been expected if, during the early stages of a recrudescence of the disease on the continent of Europe, cholera had been imported anew into this country. It was because of the well-known chances of importation in this obscure form that the Cholera Survey of our ports and towns was instituted, and it must be admitted that, in Grimsby at least, that which actually took place is precisely what might reasonably have been anticipated. Indeed, I can feel but little doubt that not later than mid-July cholera from abroad made its way anew into Grimsby, and thence into the neighbouring town of Cleethorpes, and that the "diarrhœa," which alone was at first apparent, soon assumed a type so significant, in point of fatality and otherwise, as to have called for the adoption of exceptional measures of prevention at a much earlier period than that at which these were actually practised. The returns as to the earlier attacks of diarrhœal disease in the third quarter of 1893 are too incomplete to enable me to say in what relation the diarrhœal outbreak in Hull stood, in point of time, to that in Grimsby, but it is certain that whereas disease which was classed as "choleraic diarrhœa" or "cholera nostras" was ominously fatal in Grimsby from the beginning of August, no deaths were attributed to like causes in Hull until late in the month. It does not follow from this that Hull necessarily received its cholera, in 1893, from Grimsby, for

both ports were at the time in relation with infected districts on the continent of Europe; but such a sequence of events is not improbable in view, not only of the communication existing between the two port towns, but also of the subsequent relation of the cholera prevalence in Grimsby and Cleethorpes to cholera in other parts of England.

These two latter towns, which for present purposes may be regarded as one, are visited every summer by enormous numbers of the artisan class, especially from South Yorkshire, South Lancashire, and the North Midland Counties. In the six months May–October, 1893, no less than 235,721 excursionists were booked to these towns by the Manchester, Sheffield, and Lincolnshire Railway, and this notwithstanding the fact that during two months of that period it was well known to the public that cholera was prevalent in both places. A large proportion of the excursionists stay only a single day in the locality, and with many others the stay is one of very short duration. They come to the Humber sea-side resort for a few hours, and then, as it were, radiate out from it, as a centre, as they return to their homes. In a number of instances it is known that cholera was first recognised in certain parts of England either as occurring in persons who had arrived from Grimsby and Cleethorpes, or in the immediate relatives and friends of such persons, and that the outbreak of the disease was so related to the date of the sea-side visit as to make it probable that the one had concern with the other. And when the maps are examined with which Dr. Barry's report is illustrated, and which show the topographical distribution of cholera in England during 1893, it will be seen that, apart from importations into ports, 34 out of the 50* places in which choleraic outbreaks occurred in England, lie within an angle having its apex at the mouth of the Humber, and of which one side passes southwards through Leicester, and the other northwards through York. Indeed, outside this angle, which includes the area from which the excursionists referred to were mainly derived, there only occurred 39 out of the total of 287 cases of cholera and reputed cholera which were recorded in England last year. Even these 39 are not necessarily to be regarded as being cases that had no concern with the Humber sea-side resort—in some, indeed, such relation was, to say the least, suspected—and it will be obvious that the scattering of nearly a quarter of a million of people, who had spent some time in a cholera-infected locality, afforded exceptional opportunities for a like scattering of the cholera poison over a wide area of England, and this under circumstances that would make it well-nigh impossible in many cases to follow out the channels by which infection may have been conveyed. Happily, the tripper's stay in Grimsby and Cleethorpes was commonly one of hours rather than of days, otherwise the resulting mischief would probably have been on a

* The Metropolis is here regarded as a unit.

wider scale: and, happily for England, in neither town did the specific infection get access to a public water service.

Shellfish and the Spread of Cholera.

There is another matter which deserves consideration in connexion with the influence of Grimsby and Cleethorpes on this prevalence of cholera. In a number of cholera attacks the antecedent history of the sick involved either the consumption, or the reception at their homes, of oysters or other shell fish which had been procured at or derived from Cleethorpes and Grimsby; and under these circumstances Dr. Reece was instructed to include in his Report (Appendix A., pages 86–88) some account of the trade in oysters, mussels, and cockles, as carried out in these places. This account shows not only that the oyster beds at Cleethorpes are almost necessarily bathed each tide with the effluent from the Grimsby and Cleethorpes sewers, but that oysters are so stored inside the Grimsby docks as once again to expose them to contamination by sewage. The mussel trade is worked under nearly identical conditions, but the mussels are more exposed to sewage than even the oysters. The cockles are mostly used for consumption in the district, but one large bed of them is stated to be "exceptionally exposed to the influence "of Grimsby and Cleethorpes sewage." Some of these shell fish are not often eaten raw; others again, notably oysters, are largely consumed without cooking, and when so eaten the removal from the shell of the liquid in which the oysters lie is a thing that is generally somewhat carefully avoided. The state and sources of the "waters" in which the oysters are grown or kept come, therefore, to acquire importance in so far as the public are concerned; and having regard to the significant indications afforded by some of the cholera histories of last year, I cannot avoid the conviction that shell fish from Cleethorpes and Grimsby must, in some cases, remain under suspicion as having contributed to the diffusion of the disease.

In opposition to this view it has been alleged that, having regard to the enormous operations of the Cleethorpes oyster trade, the effects, if any, could hardly have been so limited as appears to have been the case last autumn. But this argument has not much weight when it is remembered that, with regard to oysters, for example, as a channel for conveying the infection of cholera, it would be necessary that the shell or body of the mollusc should retain some portion of the sewage, which on this coast is stated to be enormously diluted with sea water; that such sewage should happen to comprise some of the cholera infection which last autumn was passing from the sewer outfalls; and, further, that this poison should be received by some susceptible person without prior destruction by a process of cooking. The concurrence of conditions such as these in regard of persons not otherwise exposed to cholera infection, is by no means likely to have been habitual; and it is the conviction that their co-existence must have been comparatively rare that prevents me from speaking in more positive terms as to the

precise relation of the shell-fish trade in these Humber towns to cholera in England in 1893.

But one thing is certain. Oysters and shell fish, both at the mouth of the Humber and at other points along the English coast line, are at times so grown and stored that they must of necessity be periodically bathed in sewage more or less dilute; oysters have more than once appeared to serve as the medium for communicating disease, such as enteric fever, to man; and so long as conditions exist, such as those with which the oyster trade of Cleethorpes and Grimsby is shown to be associated, conditions which may at any time involve risk of the fouling of such shell fish with the excreta of persons suffering from diseases of the type of cholera and enteric fever, so long will it be impossible to assert that their use as an article of diet is not concerned in the production of diseases of the class in question.

Central Administrative Action.

At the beginning of the year 1893, the Medical Department had been strengthened by the addition to its staff of two permanent and four temporary Inspectors, and thus re-inforced much was done for the prevention of cholera that would otherwise have been difficult if not impossible of achievement. Whilst I shall reserve an account of the action taken under the general Cholera Survey of our port and inland sanitary districts for my report on the proceedings of the Department during the official year 1893–94, I propose to refer at once to the more special action that was taken by the Medical Department, as attacks of cholera or of reputed cholera came within the cognizance of the Board.

The Board having announced beforehand that they were prepared to institute such bacteriological researches as would assist sanitary authorities in differentiating, as regards first cases of choleraic disease, between true cholera and diarrhœal disease having certain like features, a very large number of attacks of disease, more or less resembling cholera, came within the knowledge of the Medical Department at an early stage of their occurrence. The information transmitted was often accompanied by material derived from the sick, and was followed by some clinical history of the cases in question. Such advice as could be given promptly, either on the clinical aspects of the case, or as the result of preliminary microscopic investigation of material received, was at once despatched by telegraph; and this, as will be hereafter related, was followed by further action as the later circumstances and investigations indicated. The work of the Medical Inspectors was so contrived that a certain number of them were always available for immediate service in connexion with such occurrences, and in a considerable number of cases they acted on instant instructions and at once left for the localities which were in question,

with a view of eliciting more detailed information, of assisting, where necessary, in the diagnosis of the disease which had occurred, and of advising as to the more immediate measures of prevention that were necessary. In some instances these visits were renewed more than once; and in certain localities the measures of sanitary control were throughout under the supervision of the Board's Inspectors. By means such as these the Board were kept in immediate touch with much that might otherwise have escaped their notice until after production of the very results which it was their object to avoid. On the other hand, the record which I append to this Report shows that there were instances in which, owing to the difficulty experienced in apprehending the precise nature of one or more early attacks, communication with the Board was delayed, and there was extension of cholera, with corresponding loss of life. But, reviewing these administrative measures as a whole, I have no hesitation in saying that they materially contributed to the control of cholera in this country, and I may, perhaps, be permitted, under the exceptional circumstances of this special report, to place on record my high appreciation of the services which were rendered, during the autumn of 1893, by the staff of Medical Inspectors acting under my direction. Emergency work of the class referred to was for some time all but incessant and the Inspectors were often engaged in their duties both by night and by day; but on no occasion were the claims of duty subordinated to considerations of personal comfort or even of health.

In the case of Grimsby and Cleethorpes only was it necessary to proceed beyond such action as I have described. Cholera was already established in both these places when it first came within the Board's cognizance, and it was hence deemed requisite at once to issue the epidemic regulations to which I have referred, and to declare them in force within both of the urban areas and in the Port Sanitary District concerned.

Bacteriological Investigations.

The discovery by Koch in 1883, during the cholera epidemic in Egypt, of his comma-bacillus gave a new impetus to the study of the intimate pathology of disease exhibiting the symptoms of cholera. In the course of the next few years, cholera being meanwhile prevalent in certain countries bordering the Mediterranean, a number of different observers made independent announcement that in true (Asiatic) cholera *alone* is the vibrio in question found inhabiting the intestine of the human subject. Antecedent therefore to the most recent extension of cholera to Europe, the presence of Koch's commas in the dejecta of a person suffering choleraic attack had become generally accepted by etiologists as identifying such illness with true cholera. Further, bacteriologists—whether they belonged to that larger section of observers accepting Koch's comma as the

vera causa of cholera, or were among the few who inclined to regard this vibrio as rather a consequence than the cause of that malady—had also become agreed as to the importance, for diagnostic purposes, of detecting in the dejecta of persons suffering attacks of cholera-like nature the presence of Koch's comma-bacillus. But, in 1892, when cholera again invaded Europe, differentiation of Koch's vibrio from other microbes that can inhabit the human intestine was neither easily nor quickly attainable. Morphologically this vibrio could not with certainty be distinguished from other and similarly shaped bacteria. Only by its behaviour on artificial culture in solid media—as for instance gelatine—could it be satisfactorily differentiated from other vibrios. And, as is well known, on artificial culture in media of this class the characteristic features of Koch's vibrio are not manifested until after lapse of a considerable interval of time. The desideratum therefore in 1892 was—some means whereby this vibrio that is held to be associated with true cholera, but with no other disease, could not only be easily identified in the dejecta of persons attacked, but identified with a promptitude allowing of proper precautions being at once taken in regard of each cholera case as soon as it arose.

Accordingly in 1892 bacteriologists generally, and particularly those of the German nation, to whom the cholera outbreak at Hamburg in August of that year afforded exceptional facilities for such study, set themselves to discover means of promptly identifying in the bowel contents of cholera cases the vibrio in question. And in this direction a considerable amount of success was ere long obtained.

It was matter of general observation in the course of the 1892 epidemic in Western Europe that not only was Koch's vibrio present in the bowel contents of sufferers, often to the almost complete exclusion of other micro-organisms, but that it tended to distribute itself in very definite arrangement in the débris of their intestinal mucous membrane. Thus, in the shreds of epithelium which abounded in the rice-water dejecta of the Hamburg cases, numerous comma-bacilli could, in microscopic specimens from nearly one-half of the cases examined, be seen arranged in very peculiar grouping. The vibrios in such microscopic specimens were observed to lie with their long axes in the same direction; so that a group of them resembled a shoal of fish in the act of stemming a slowly flowing stream. In no other disease except cholera, Professor Koch affirmed, is this appearance witnessed; and thus he came to regard such grouping of commas in the intestinal flakes as absolutely diagnostic of true cholera. As to cases, indeed, responding in this way to microscopic test, Dr. Koch further insists that entirely trustworthy evidence of their being true cholera can be obtained within a few minutes only of submission of material from them to the procedures of the skilled bacteriologist; for, as he points out, the positive evidence thus obtained in Hamburg cases had never been called in question on

subsequent testing of the same material by the older and more deliberate method of culture on artificial solid media.

But though, in this way, nearly half the cases occurring in Hamburg could be immediately identified as true cholera, it was also found that in the larger proportion of attacks microscopic testing, in the above sense, of the raw material gave equivocal or negative results. Either the cholera vibrios in the epithelial flakes or fluid contents of the bowel were outnumbered by other microbes, and failed, therefore, to present under the microscope the arrangement characteristic of cholera; or, they were not to be detected at all by this comparatively rough-and-ready process. For failure, however, in this sense, a remedy was found. It was ascertained that in Dunham's peptone solution a means was at hand for sorting out Koch's commas from among a multitude of similar and dissimilar microbes. In this fluid medium—which consists of one per cent. peptone and half per cent. sodium chloride—the vibrio in question gets the start, so to speak, for the time being, of all micro-organisms with which it is associated, multiplies itself exceedingly, and in its eagerness for oxygen colonises the surface of the peptone solution to the exclusion of the other microbes; so that in the upper portion of this medium, when rendered turbid by its life processes after incubation for half a dozen hours at 37° C., Koch's vibrio is found practically in pure culture—as may be verified by microscopic examination of droplets of the medium as cover-glass specimens. Furthermore, this vibrio has, it was found, the faculty of evolving in this same peptone solution—and with a rapidity parallel to its own multiplication there—indol and nitrites, the presence of which is, on the addition of a drop or two of pure sulphuric acid, at once revealed by development in the peptone tube of a rose-blush colour—the so called "cholera-red" reaction.

When therefore, in 1893, cholera having become recrudescent in Western Europe, cases of the malady, imported or indigenous, were reputed to be making their appearance in this country, means were seemingly at hand for determining—in something like half the cases in a few minutes, in the remainder within 24 hours—whether, from the bacteriological view-point, any suspected attack was one to be dealt with as true cholera. In these circumstances, and to the end that Sanitary Authorities should not be hampered in their administrative measures by uncertainty as to the nature of the cholera-like disease appearing in their districts, the Board undertook the duty of ascertaining through Dr. Klein, as regards *first* cases of reputed cholera, whether or not the dejecta of the patient contained Koch's comma bacillus. Accordingly, Sanitary Authorities giving timely notice—along with certain necessary particulars—to the Board of the occurrence in their districts of attacks suspected to be cholera, were invited to forward to the Medical Department material (dejecta or actual bowel, according as the attack was non-fatal or fatal) from such cases with a view to its submission to Dr. Klein

for bacteriological examination and report. And meanwhile the necessary arrangements were made for transmission with the least possible delay to each Sanitary Authority, thus seeking the Board's assistance, the facts ascertained by Dr. Klein in the particular instance. As a result of this action by the Board, material from 53 reputed cases of cholera in various parts of the country was examined and reported on by Dr. Klein, and, as will have appeared in the comments I have made as regards one and another sanitary district, the operations in the repression of cholera carried out by many local authorities were hereby materially assisted.

Dr. Klein's detailed account of his procedures and their results (Appendix B.), studied in connexion with the facts elsewhere recorded in this volume respecting the clinical histories and antecedents of the cases he deals with, will prove of not less interest to the etiologist than to the pathologist. In the main, he followed in his investigation of the materials submitted to him the lines that have already been referred to as advocated by Professor Koch. Thus:—

As matter of first instance, Dr. Klein took note of the physical condition of each sample of material (dejecta, or bowel and bowel contents), and then at once proceeded to microscopic examination of these matters by means of cover-glass specimens. Whether or not indication was thus obtained of the presence in the material of Koch's comma-bacillus, cultures were at the same time instituted in peptone salt solution, samples of which, after incubation for six hours, were in turn examined at short intervals by the cover-glass method, and finally, after 12 to 16 hours' incubation, this medium itself was tested for cholera-red reaction. And always, even though the peptone test gave positive results, sub-cultures from the peptone medium were for additional security established in the orthodox solid media—gelatine and agar.

In a minority of the cases examined, cover-glass specimens of the epithelial flakes from the intestine revealed comma-bacilli unmixed with other organisms, and arranged in the manner regarded by Koch as belonging only to cholera. With reference to cases of this sort the Sanitary Authority concerned was at once informed that the attack was, in all probability, true cholera; and later, when the diagnosis thus provisionally arrived at by Dr. Klein had been confirmed by the results of culture by him of the material in peptone salt solution, the Authority was duly apprised of the fact of such confirmation.

But more commonly microscopic examination of the raw material from the intestine, though perhaps giving rise to suspicion, afforded no sufficient indication of the presence therein of Koch's vibrio. In these cases Dr. Klein's diagnosis was not pronounced until culture of the material in peptone salt solution had supplied evidence positive or negative as to the presence of Koch's commas. Information to the Sanitary Authority as to the

bacteriological dictum respecting cases of this description was consequently delayed some 12 to 16 hours.

In yet another class of case, direct culture of the raw material in peptone salt solution proved equivocal or negative, and, indeed, cases were met with wherein this result followed, though examination of the raw material by the cover-glass method had seemed to give what were regarded, bacteriologically, as "positive" results. As regards doubtful material of this sort, sub-cultures were set going in secondary (or even in tertiary) peptone tubes, and from these in turn solid media were inoculated and duly incubated at proper temperatures before a judgment was arrived at for or against the presence in the material of Koch's cholera vibrio. Meanwhile the Sanitary Authority concerned was duly informed of such suspicions as so far were indicated. Subsidiary testings in this fashion of necessity involved considerable expenditure of time, and hence in particular instances a final bacteriological decision as to the nature of the case was not forthcoming until after the lapse of two or more days.

Passing next to details of the results obtained by Dr. Klein, the 53 reputed cholera attacks reported on by him may be resolved into three groups or series, thus:—

Series (*a.*).—Fifteen cases in regard of which microscopic examination of the stools or bowel contents sufficed to indicate the presence of epithelial flakes containing comma-bacilli, not only in pure culture but distributed also in the fish-like arrangement which Koch considers absolutely characteristic of true cholera. In each of these 15 cases the above result was obtained within a few minutes of receipt by Dr. Klein of the raw material, but, as has been already intimated, in no instance was a definite diagnosis of true cholera pronounced by him until the presence of Koch's comma-bacilli in the material had been also demonstrated as the result of the peptone culture test.

Series (*b.*).—Other fifteen cases wherein microscopic examination of the stools or bowel contents gave equivocal or negative results, but in regard of which the application subsequently of cultural tests proved the presence in the material of Koch's cholera vibrio. All these 15 cases, like the 15 in series (*a*), were accordingly pronounced, from the bacteriological view-point, to be true cholera. And,—

Series (*c.*)—Twenty-three cases as to which the presence of Koch's vibrio in the material submitted to him could not be demonstrated by any of the means at Dr. Klein's disposal.

So that of the total 53 cases dealt with by Dr. Klein, as many as thirty (56·6 per cent.*) were found, bacteriologically, to be true cholera, while in twenty-three (43·4 per cent.) the evidence was, from Dr. Klein's point of view, negative in character.

These bacteriological dicta by Dr. Klein were necessarily independent of the clinical histories and the antecedents of the

* See Dr. Klein's table of facts respecting his 30 "positive" cases, pages 190–91.

cases upon which he was reporting. For the most part he knew nothing of these matters, and even in regard of particular cases as to which he did receive some information, the facts in nearly every instance came to hand *after* his bacteriological dictum had been pronounced. In these circumstances, the clinical features and the antecedent histories recorded elsewhere in this volume, of the 30 and of the 23 cases respectively, become of the greater interest and importance. The facts in this connexion are briefly as follows :—

First.—As to Dr. Klein's 30 *positive* cases—included in series (*a.*) and (*b.*)—in regard of which a bacteriological verdict of the cholera was arrived at. Almost without exception they were found to have presented symptoms indistinguishable from those of Asiatic cholera. All but two proved fatal, generally within 24 hours of attack, and those of them which recovered or in which a fatal termination was delayed beyond 24 hours, were for the most part among the cases in which the clinical symptoms had been least equivocal in their suggestion of true cholera. In short, judged in their clinical aspects, they came nearly every one of them under grave suspicion of true cholera, and from this view-point, therefore, the positive evidence to the same effect afforded by Dr. Klein's investigations of their stools or bowel contents might seem to a corresponding extent superfluous. When, however, regard is had to their antecedent histories, the dictum of bacteriology that they were all of them true cholera is seen to be not without important and practical bearing. Only in a minority of instances had the persons whose attacks are in question been residing in localities where unmistakeable cholera had already manifested itself, or in which definite cholera not long afterwards made its appearance More than half the 30 cases occurred under circumstances which, but for bacteriological testimony as to the real nature in each instance of the malady, would have tended to discount the clinical features of the attacks in the direction of suggesting to the authorities, medical or other, concerned, that the attacks in question were examples merely of "English" cholera, and not, therefore, calling for measures of precaution such as are admittedly necessary when the Asiatic variety of cholera is detected in a given locality. There can be little question, indeed, that in regard of a considerable proportion of these 30 cases the action taken by the Board in putting them to the bacteriological test encouraged the local Sanitary Authorities to preventive measures that might otherwise have been carried out in less thorough fashion than in the actual circumstances was shown to be desirable, or even delayed until extension of cholera in the locality had demonstrated urgent need for them. The *positive* evidence, therefore, that was obtained, through the Board, from bacteriology respecting the nature of cholera-like attacks, has been distinctly of advantage to local sanitary administration.

Secondly, with reference to Dr. Klein's 23 *negative* cases, *i.e.*, those in regard of which he failed to find, by any of the methods at his disposal, evidence of the presence of Koch's cholera vibrio. Here the testimony of bacteriology would appear less satisfactory. It is true that these 23 cases comprised half-a-dozen attacks, as to which the material submitted to Dr. Klein had been previously exposed to germicidal influences, or was forwarded at so late a stage of the person's malady as to be practically useless for his purposes; that hardly more than half of the 23 proved fatal; that in such as were fatal, death was often much delayed; and that the antecedent conditions under which the 23 had lived were rarely such as to class them with cholera. Nevertheless, they included not a few attacks that clinically could not be distinguished from true cholera; some of them, indeed, with antecedents tending to presumption that the cases were of the Asiatic variety.

This last-mentioned experience, namely, the absence of bacteriological proof of true cholera in cases which clinically and otherwise directly indicated that disease; as also, bacteriological affirmation of true cholera in cases which did not clinically or by reason of their antecedents seem to justify such diagnosis; determined the Board to direct in 1894 more extended investigation of the comparative bacteriology of "English" and Asiatic cholera.

Several points of interest, arising from Dr. Klein's observation of reputed cholera material, remain to be dealt with. Dr. Klein, fully accepting the view that identification of Koch's vibrio in the dejecta (or bowel contents) of a person suffering choleraic attack suffices for diagnosis of true cholera, notes, in regard of his further experience in 1893, certain easily ascertained indicia as to its presence, to be obtained by microscopic examination of raw material from reputed cholera cases; and he discusses at length the behaviour of this vibrio in his hands on culture in a variety of artificial media.

As to indicia referred to, Dr. Klein found that in every one of the cases in which this organism was demonstrated by subsequent culture in peptone salt solution or other media, epithelial flakes were more or less numerous in the stool or bowel contents. But, on the other hand, several cases came under his notice in which, though he discovered epithelial flakes in the raw material sent him, his subsequent culture of the samples in the usual media failed to reveal the presence of Koch's vibrio. The presence, therefore, of epithelial flakes in the rice-water stool would appear, judged bacteriologically, a less certain indication of true cholera than had been thought by some observers. Given, too, the presence in the raw material of epithelial flakes, in a minority of cases only did Dr. Klein find Koch's vibrio in pure culture in such flakes and arranged therein in the manner regarded by Koch as characteristic of true cholera. More frequently in Dr. Klein's experience comma-shaped

organisms were with difficulty discovered in the flakes, and sometimes were not to be found there at all, even in cases in which their presence was subsequently demonstrated by appropriate cultural tests. However, as regards the great majority of the cases subsequently proved culturally to be true cholera, Dr. Klein found in the raw material an indicium that he is disposed to regard as of great importance in making provisional diagnosis. This was the presence in the epithelial flakes, or in the fluid containing them, of free flagella that had become dissevered from the vibrios to which they belonged. But this again proved no certain criterion, for in certain of the cases in which flagella-like bodies were numerous in the raw material, Dr. Klein was unable to detect Koch's vibrio by cultural experiment.

With reference to his cultural observations of the vibrios obtained by him in 1893, from the reputed cases of cholera, Dr. Klein is fully confirmed in a suspicion previously entertained by him, namely, that comma-bacilli from different cases of true cholera exhibit biologically, in the laboratory, marked and stable differences *inter se*. For instance, the cholera comma as obtained by him from a particular case failed to liquefy gelatine when grown therein in stab-culture, although in all respects it responded to the tests for Koch's vibrio; and in several other instances comma-bacilli from different cholera cases were able sooner or later to curdle milk, a function not possessed, as Koch himself points out, by Koch's vibrio. In their behaviour, too, in other culture media, certain of the comma-bacilli isolated by Dr. Klein differed in minor ways from that noted by Koch in regard of his cholera vibrio. And as a result Dr. Klein has come to consider the comma-bacilli obtained by him in 1893 from cholera cases in this country as representing at least several varieties of cholera vibrio. He is, indeed, disposed to suspect that under the term "Koch's Vibrio," there may be included more than one distinct species of microbe.

Diarrhœal Outbreak at Greenwich Workhouse.

Diarrhœal Outbreak at Greenwich Workhouse.

In connexion with these investigations as regards cholera in England during the year 1893, much interest attaches to the occurrence of a diarrhœal outbreak which prevailed in the Greenwich Union Workhouse, and which is reported on at length by Dr. Bulstrode (*see* Appendix C.). The first attack which came to the knowledge of the medical officer of the institution commenced on October 4th, but between that date and October 24th, 240 inmates and 5 nurses had been attacked, besides which 4 cases were imported from without. Eleven of the cases terminated fatally, all the deaths occurring in persons attacked between October 8th and 12th. The more obvious clinical characters of the disease were as follows:—The patients commonly awoke early in the morning with severe abdominal pain, followed by diarrhœa, vomiting, and cramps; the

features became contracted, the lips and extremities were blue and cold; the voice was feeble, there was intense thirst, and generally extreme collapse. Often, too, the patients had suffered for a few days from premonitory diarrhœa. The motions and vomit were watery and inoffensive, but in no case were any typical rice-water discharges seen. There was a distinct tendency to relapse. The incidence of the disease was all but wholly on those who had passed the age of childhood, and still more especially on those over 60 years of age. The 11 fatal attacks were all in persons over 60 years. The post-mortem appearances included marked injection of the small intestine, more especially towards the ileal extremity, and an empty or contracted urinary bladder.

The outbreak having thus certain resemblances to cholera, and cases of this disease being known to prevail in certain provincial parts of England at the time, it was deemed advisable, amongst other methods of inquiry, to resort to bacteriological study; and in 12 cases material was available for such purpose. This material included stools, as well as portions of the ileum and of other organs. Dr. Klein's account of these will be found in an addendum to Dr. Bulstrode's report. In three instances distinct comma-shaped bacilli were found, but in none of these did the organisms respond to the cultural or chemical tests which are held to indicate Koch's bacilli; in one instance they were found in every respect to resemble Finkler's commas. In this latter case, flagella were attached to the comma-shaped organisms derived from a portion of ileum; and in another of the three cases free flagella were seen. In two cases micro-organisms were found which in some respects resembled comma-shaped bacilli, but cultivations from the material were altogether negative as to the recognised cholera organism. In the remaining six instances the results were negative as to existence of comma-bacilli, both microscopically and as the result of culture experiments. In one of these latter instances there were crowds of an organism which was apparently the bacillus coli. In no instance, says Dr. Klein, could the cholera bacillus be isolated by peptone culture; and in view of this and of certain other considerations he came to regard it as in a high degree improbable that the attacks in question were of the nature of true cholera.

But whilst the bacteriological investigations were thus negative as to true cholera, a definite bacillus was found in a number of the samples of material examined. This bacillus had certain marked resemblances both to the influenza bacillus and to the common putrefactive microbe, proteus vulgaris; but it also presented certain points of difference to both. For the moment, it would appear to be a distinct micro-organism belonging to the same group as the proteus vulgaris; and there is no indication of its having had any causal relation to the outbreak.

In the meantime, exhaustive inquiry as to the cause of this outbreak was proceeding in other directions, and certain

structural and administrative arrangements of the several buildings comprised in the institution tended to facilitate the exclusion of one or other condition as a cause of the disease. Thus the buildings included both a workhouse and an infirmary. The inmates of the workhouse at the date of the outbreak were 1,179 in number, and of these no less than 238 were attacked; the infirmary contained 380 inmates and 40 nurses, and of these only two inmates and one nurse were attacked, and this although there were certain inter-relations between the two establishments. The drainage of the workhouse is in large part distinct from that of the infirmary, and that belonging to the workhouse presented obvious defects. But one wing of the workhouse has its drainage in common with the infirmary, and it was in this wing that the earliest manifestation of the outbreak occurred. For this and other reasons conditions of drainage offered no satisfactory explanation of the occurrence. Water came early under suspicion, for whilst the workhouse water was derived from a well which gave indications of being subject to the risk of pollution, no similar suspicion attached to the supply derived from a separate deep well at the infirmary. On further investigation the workhouse water was pronounced to be chemically bad, and when microscopically examined it was found to contain not only the bacillus coli, which is commonly derived from the human large intestine, but amongst other micro-organisms, one which morphologically did not differ from the cholera vibrio. But when further studied by cultural tests, this comma-shaped organism failed to respond to the tests which are regarded as indicative of the true cholera vibrio. This well water must be regarded as having in all probability been subject to pollution by reason of leakage from a defective drain or drains in its vicinity; and its relation to the outbreak in the workhouse would have appeared a reasonable solution of the diarrhœal outbreak, were it not that amongst somewhat over 70 children under 16 years of age, and who were supplied with this well water, there only occurred one attack which resembled the malady prevailing amongst the adult inmates. There were, however, several smart attacks of diarrhœa amongst infants in the general wards during the period in question.

No question of food supply was found to account for the epidemic malady. Not only were the articles of diet in the workhouse and in the infirmary practically identical, but the character of the diarrhœa differed from that which is known to be due to so-called "food poisoning."

One thing seems clear, namely, that the diarrhœal disease had some infective quality. This is shown by its exceptional incidence on the workhouse staff of whom 16 per cent., and on the nursing staff of whom 33·3 per cent. were attacked; and the excess of its incidence on female inmates as opposed to males appeared capable of being explained in the same way.

During the course of Dr. Bulstrode's inquiry it transpired that, antecedently to any recognised attacks in Greenwich

Workhouse, there had been in certain parts of Greenwich beyond the precincts of the workhouse, an occurrence which, though limited in point of numbers, was clinically the counterpart of that which took place within its precincts. This prevalence in Greenwich commenced towards the close of September; and as in the workhouse, persons coming into immediate contact with the sick contracted the disease. Three medical practitioners suffered in this way.

It would thus appear that in Greenwich town, and subsequently in Greenwich Workhouse, there occurred in the months of September and October 1893, an outbreak of acute diarrhœal disease, which in many of its clinical aspects was not unlike that form of diarrhœa with which outbreaks of definite cholera have so commonly been associated; that, pathologically, the disease presented certain features resembling those met with in cholera, whilst it lacked others deemed characteristic of the Asiatic disease; and that bacteriologically, whilst there were some microscopic indications in a few cases that were at first suggestive of true cholera, the material examined in the majority of the cases lacked these indications, and in no case was a first suspicion of cholera confirmed as the result of cultivation experiments. There is also strong suspicion that the disease was introduced into the workhouse from without. Facilities for such introduction undoubtedly existed; indeed the attack which first brought the outbreak under notice took place in the person of an inmate who was spending the day away from the institution. There is also every reason to suppose that mild attacks, whether contracted within or outside the workhouse, could easily have escaped notice before medical recognition of the prevailing malady. If the disease was imported it soon found opportunity for spread; although it is difficult to account for the rapidity and extent of its diffusion by means of infection conveyed from person to person. How far some circumstances connected with the workhouse well water, which were undiscoverable at the time that inquiry was undertaken and when the disease was on the wane, could have operated to produce the mischief within the limits of its special incidence on different buildings and on different sets of inmates remains undetermined.

I have the honour to be,
Sir,
Your obedient Servant,
R. THORNE THORNE.

December 1894.

No. 1.

Report on Cholera in England and Wales in 1893; by Dr. F. W. Barry.

During 1893, as in 1892, cholera was from time to time imported from abroad to one and another port of England and Wales. But in an important respect the behaviour of cholera in 1893 in this country differed from that observed in 1892. The disease made its appearance, though to a limited extent among the resident population of particular localities.

In the following report I have the honour to submit a detailed account of (*a*) cholera detected on vessels arriving in England and Wales "from foreign" during 1893, and (*b*) reputed cholera among English communities during the same year.

In each instance the facts are dealt with chronologically. As regards ship-borne cholera, the ports implicated are taken according to the date of arrival of infected vessels, or to the date of development (after arrival) of cholera on shipboard. And as regards cholera among our own population, the several localities in which the disease made its appearance are dealt with in the order of the date of occurrence, in each, of a first case.

In the following Table I. will be found a complete list, arranged chronologically, of all the ports at which ship-borne cholera was detected, and of the separate localities in England and Wales where disease of the nature of cholera appeared during 1893. The original list of inland localities reported as affected by cholera was larger than that now to be given; diminution of the list and reduction of the cases reported is due to the circumstance that in several instances inquiry, local and other, had shown the malady in question not to be cholera; but, notwithstanding this procedure, it is believed that not a few of the attacks that will be reckoned as cholera in this report were not, as a matter of fact, examples of that disease; they have been included, however, for the purpose of avoiding suggestion of understatement of cholera prevalence. The localities eliminated were 14 in number, and were as follows:—Ashton-under-Lyne, Bingley (town), Braintree, Darwen, Frislington, New Swindon, Leeds, Tavistock, Woodford, Greenwich Workhouse, Poplar, Woolwich, St. George's, Hanover Square, and St. Pancras.

In Table I. the names of the ports at which ship-borne cholera from foreign was detected are printed in italics, and the names of the metropolitan districts in small capitals. In the last two columns of the Table, the pages of the report, at which the history of the individual outbreak, and the results of the bacteriological examination, when made, are given respectively.

Table I.

Cholera and Reputed Cholera in England, 1893.

Date of Occurrence in Locality of earliest Case reputed to be of the Nature of Cholera.	Name of Sanitary District.	Population 1891. (In case of Cholera on Shipping, Name of Vessel.)	Reported Origin of Infection.	Page of Report on which Account will be found as to—	
				History of Outbreak.	Results of Bacteriological Examination.
June 25	*River Tyne Port*	"Myrtle Branch."	Nantes	4	—
July 18	*Cardiff Port*	"Blue Jacket"	Marseilles	6	—
„ 20	*London Port*	"Altmore"	Marseilles	6	6
„ 24	*Liverpool Port*	"Ant"	St. Petersburg	6	—
Aug. 2	*Grimsby Port*	"Dania"	Antwerp	6	—
„ 9	Grimsby U.	51,934	?	12, 47	177, 185
„ „	Lincoln U.	41,491	Cleethorpes	13	—
„ 15	Cleethorpes U.	4,306	?	13, 47	—
„ 16	Kingston-upon-Hull U.	200,044	?	13, 89	176, 177
„ 18	Shoreditch (M.)	124,009	?	14	—
„ 23	*Liverpool Port*	"Mananeuse"	Havre	7	—
„ 24	Rotherham U.	42,061	Grimsby	15, 169	177
Sept. 2	Monk Bretton U.	3,426	Cleethorpes	15	—
„ „	Tetney Parish (Louth R.).	775	Grimsby	16	—
„ 3	Bradford U.	216,361	?	16	—
„ 4	Middleton U.	22,162	?	16, 119	—
„ 5	Brigg U.	3,100	?	17	—
„ „	St. Margaret and St. John the-Evangelist, Westminster (M).	55,539	?	17, 123	177
„ 6	Boston U.	14,593	?	17	178
„ „	Ashbourne U.	3,809	?	18, 127	180
„ „	Appleton-le-Street Parish (Malton R.).	151	Cleethorpes	18, 132	182
„ 6	St. Marylebone (M.)	142,404	?	18	18
„ 7	Willesden U.	61,265	Grimsby	19	179
„ „	Doncaster U.	25,933	Cleethorpes	19	178
„ „	Morton Parish (Gainsbro' R.)	1,137	?	20, 136	179
„ 8	Bethnal Green (M.)	129,132	?	20	—
„ „	Great Yarmouth U.	49,334	?	20, 142	182
„ „	Clerkenwell (M.)	66,216	?	20	178, 181
„ „	Mansfield U.	15,925	Grimsby	23	180
„ 9	Great Clacton U.	3,584	?	23	179
„ „	Leicester U.	174,624	Cleethorpes	23	179
„ „	Ilkeston U.	19,744	?	24, 145	182
„ „	Handsworth U. (Yorks).	10,295	?	24	179
„ 10	Fulham (M.)	91,639	?	25, 148	179
„ „	South Shields U.	78,391	?	25	26
„ „	East Retford U.	10,603	?	27	179

Date of Occurrence in Locality of earliest Case reputed to be of the Nature of Cholera.	Name of Sanitary District.	Population 1891. (In case of Cholera on Shipping, Name of Vessel.)	Reported Origin of Infection.	Page of Report on which Account will be found as to—	
				History of Outbreak.	Results of Bacteriological Examination.
Sept. 11	Mitcham Parish (Croydon R.)	12,127	?	27	180
„ „	Lambeth (M.)	275,203	?	29	180
„ „	Manchester U.	505,368	Grimsby	29	29
„ 12	Hurst U.	6,772	Cleethorpes	30	—
„ 13	London Port	"Memory"	?	30	—
„ „	Accrington U.	38,603	?	31	181
„ „	Croydon U.	102,695	?	32	180
„ „	Owston Parish (Gainsbro' R.).	1,294	Hull	33, 137	—
„ 14	Newington (M.)	115,804	?	33	181
„ „	Derby U.	94,146	?	33	181
„ „	Stockton-on-Tees U.	49,705	?	34	181
„ „	St. Luke (M.)	42,440	?	35	180
„ 17	Blackburn U.	120,064	?	35	182
„ „	River Tyne Port	"Jeannie"	?	36	36
„ 18	Hackney (M.)	229,542	?	36	182
„ „	Liverpool U.	517,980	?	37	182, 184
„ „	North Bierley U.	22,178	?	38, 151	185
„ „	*Southampton Port*	"Glenmore"	Braila	7	—
„ 20	Lewisham (M.)	92,647	?	38	182
„ „	Newcastle-on-Tyne U.	186,300	?	39	39
„ 22	Idle U.	7,118	?	39	40
„ 23	*London Port*	"Ashbrook"	Cronstadt	7	7
„ „	Islington (M)	319,143	?	40	—
„ „	St. George-the-Martyr, Southwark, (M.)	59,712	?	40	183
„ „	Rowley Regis U.	30,791	?	41, 155	183
„ 24	West Malling Parish (Malling R.)	2,254	?	41	184
„ 26	Coton Hill Lunatic Asylum, Stafford.	199	?	42, 159	184
„ 30	Battersea (M.)	150,558	?	42	—
Oct. 1	*River Blyth Port*	"Ashbrook"	Cronstadt (London.)	8	—
„ 2	Crondall Parish (Hartney Wintney R.)	3,898	?	42	185
„ 3	Gloucester U.	39,444	?	43	184
„ 6	Ormskirk U.	6,298	?	43	185
„ 7	Balby Parish (Doncaster R.)	4,270	?	44	185
„ 9	Rawmarsh U.	11,983	Rotherham.	44	186
„ 13	Keighley U.	30,810	?	45	186
„ 16	Warrington U.	52,743	?	45	186
„ „	Bingley Township U.	10,023	?	46	186

App. A. No. 1.

From the above table it will be observed that up to the *first week in August* cases of cholera from foreign were detected on shipboard at the five ports of River Tyne, Cardiff, London, Liverpool, and Grimsby, but that no cases of reputed choleraic disease are known to have made their appearance amongst the resident population until the *second week in August*, when cases were reported to have occurred at Grimsby, Lincoln, and Cleethorpes, all places situate in Lincolnshire. During the second half of August disease, presumably cholera, appeared at Hull and Rotherham in Yorkshire, and at Shoreditch in the metropolis. Thus during August disease of the nature of cholera appeared in five towns or villages situate in Lincolnshire and Yorkshire, and in one metropolitan area. During the month of September appearances of choleraic disease were reported to have taken place in 50 additional localities situate in the following counties: Lincolnshire, 5; Yorkshire, 7; Lancashire, 6; Derbyshire, 3; Nottinghamshire, 2; Durham, 2; Surrey (extra metropolitan), 2; Northumberland, 2; Staffordshire, 2; Middlesex (extra metropolitan), 1; Norfolk, 1; Essex, 1; Leicestershire, 1; Kent (extra metropolitan), 1; and Metropolitan Districts, 14. During the month of October the appearance of disease of the nature of cholera was reported from eight additional localities situate in the following counties: Yorkshire, 4; Lancashire, 2; Hampshire, 1; and Gloucestershire, 1. After October 17th, choleraic disease was not reported to have appeared in any new locality in the country. From the above notes it will be seen that disease reputed to be cholera appeared in 64 separate localities of the Kingdom, of which 49, situate in 16 counties, were extra metropolitan, and 15 were metropolitan districts. In more than three-fifths of the localities where these attacks occurred the disease was limited to a single case.

(*a.*) *Cholera detected on Vessels arriving in England "from Foreign" during* 1893.

During 1893, notwithstanding the prevalence of cholera at numerous Continental ports having trade with this country, only 13 cases of cholera, or disease suspected to be cholera, were detected on board or connected with vessels from foreign. A list of these cases, with certain details, is given in Table II. on page 5.

These 13 cases entered the country at seven ports, namely, London 4, Liverpool 3, Cardiff 2, and the River Tyne, River Blyth, Grimsby, and Southampton 1 at each. Nine of the cases were reported between July 18th and August 23rd, two during the month of September, and one each during the months of June and October. Of the 13 cases 4 proved fatal.

The reputed source of infection in the 13 cases was as follows:—Marseilles 4, Cronstadt 2, St. Petersburg 2, Nantes 1, Cherbourg 1, Antwerp 1, Havre 1, and Sulina 1.

On June 25th the SS. "Myrtle Branch" (20 hands) arrived at the River Tyne Port from Nantes, which she had left June 20th. On her arrival it was reported that one of the crew had died three hours before her arrival after an attack having symptoms suspicious of cholera. Upon receiving an account of the history of the attack and after an examination of the corpse, the Assistant Port Medical Officer of Health had no hesitation in attributing the death to Asiatic cholera. The corpse was accordingly removed to the mortuary at the Port Floating Hospital, and the ship was sent to the mooring station to undergo the necessary measures of disinfection. No further spread of the disease was reported. The water-supply of this vessel had been obtained from the River Loire on June 7th, at a point between Nantes and St. Nazaire.

Table II.

Cholera detected on Vessels arriving at English Ports from Foreign during 1893.

No. of Case.	Date of Arrival in England (*a*), or of Attack by Cholera (*b*), whichever Event occurred latest in Point of Time.	Sanitary District whence Case notified.	Facts with respect to Vessel.						Sex of Patient.	Facts with respect to Persons attacked with Cholera.				
			Name of Vessel.	Port of Departure.		Port of Arrival.				Date of Cholera Attack.	Place of Attack.	Where isolated.	Date of isolation.	Result.
				Name.	Date.	Name.	Date.							
	1893.													
1	June 25 (*a*)	River Tyne Port	"Myrtle Branch."	Nantes	June 20	River Tyne	June 25		M	June 25	At sea	—	—	Died June 25.
2	July 18 (*a*)	Cardiff Port	"Blue Jacket"	Marseilles	July 9	Cardiff	July 18		M	July 9	„	Cardiff Port Hospital, Flatholm.	July 19	Recovered.
3	„ 18 (*a*)	„ „	„ „	„	„ „	„	„ „		M	„ 15	„	„ „	„ „	„
4	„ 20 (*a*)	London Port	"Altmore"	„	„ 3	London	„ 20		M	„ 5	„	London Port Hospital.	„ 20	„
5	„ 24 (*a*)	Liverpool Port	"Ant"	St. Petersburg, Dieppe	June 27 July 21	Liverpool	„ 24		M	June 29	„	Liverpool Port Hospital.	„ 25	„
6	„ 24 (*a*)	„ „	„	„ „	„	„	„ „		M	July 23	„	„ „	„ 25	„
7	„ 26 (*b*)	St. George in the East Urban (London).	"Altmore"	Marseilles	„ 3	London	„ 20		M	„ 26	16, Raymond Street, Wapping.	London Port Hospital.	„ 26	„
8	Aug. 2 (*a*)	London Port	"Elizabeth McLea."	Cherbourg	„ 31	„	Aug. 2		M	Aug. 1	At sea	„ „	Aug. 2	„
9	„ 2 (*a*)	Grimsby Port	"Dania"	Antwerp	„ 30	Grimsby	„ 2		M	July 30	„	Grimsby Port Hospital.	„ 3	Died Aug. 3.
10	„ 23 (*b*)	Liverpool Urban.	"Mananeuse"	Brazil Havre	„ 22 Aug. 20	Liverpool	„ 23		M	Aug. 23	171, Grafton Street, Liverpool.	Park Hill Hospital.	„ 23	Recovered.
11	Sept. 18 (*a*)	Southampton Port.	"Glenmore"	Braila Sulina	„ 18 „ 27	Southampton	Sept. 18		M	„ 30	At sea	Southampton Port Hospital.	Sept. 18	„
12	„ 23 (*a*)	London Port	"Ashbrook"	Cronstadt	Sept. 14	London	„ 23		M	Sept. 17	„	London Port Hospital.	„ 23	Died Sept. 23.
13	Oct. 1 (*a*)	River Blyth Port.	„	Cronstadt London	„ 14 „ 30	River Blyth	Oct. 1		M	„ 30	„	River Blyth Port Hospital.	Oct. 1	Died Oct. 1.

On July 18th, the SS. "Blue Jacket" (22 hands) arrived at Cardiff from Marseilles, which place she had left on July 9th. On being boarded by the Assistant Port Medical Officer of Health the captain reported that two of the crew, who had been attacked with violent vomiting and diarrhœa two days after leaving Marseilles, were still unwell. From the history of the cases, and after an examination of the patients, the Port Medical Officer was of opinion that both men were convalescing from attacks of cholera. They were accordingly at once removed to the Port Sanitary Authority's hospital on the Flat Holm Island, where they subsequently recovered. The vessel was sent to the mooring station, and after disinfection was allowed to proceed to her destination.

On July 20th the SS. "Altmore" (25 hands, 4 passengers) arrived at the Port of London, having left Marseilles on July 3rd, and Havre on July 16th. Upon medical inspection it was ascertained that on July 5th, two days after leaving Marseilles, a fireman who had been on shore there, had sickened with symptoms characteristic of cholera. When the vessel arrived off Gravesend this man had returned to duty, but was found to be still ailing and so weak that the Port Medical Officer of Health directed his removal to the Port Sanitary Authority's hospital, where he ultimately recovered. Some of the dejecta from this patient were submitted for bacteriological examination to Dr. Macfadyen of the College of State Medicine, and he reported the presence of Koch's comma-bacilli. The "Altmore" was taken to the mooring station, where the necessary measures of disinfection were carried out, the water tanks emptied and cleansed, and the bilges washed out with a solution of perchloride of mercury. A second case which occurred in connexion with this vessel on July 26th will be noticed later.

On July 24th the SS. "Ant" (20 hands, 2 passengers) arrived at the Port of Liverpool, having left St. Petersburg on June 27th, and touched at Stromness July 13th, and Dieppe July 21st. Upon medical inspection, it was ascertained that two men had been ill on the voyage, (*a*) a stoker who had been attacked with choleraic symptoms on June 29th, two days after leaving St. Petersburg, and who had suffered more or less from diarrhœa until the arrival of this vessel at Liverpool, when he was found to be in a very debilitated condition; and (*b*) another stoker who had sickened with choleraic symptoms on July 23rd, the day before the vessel reached Liverpool. The Port Medical Officer of Health directed the removal of both men to the Port Sanitary Authority's hospital at New Ferry, where they ultimately recovered. The vessel was subjected to the necessary measures of disinfection and no further cases were reported.

On July 26th a case of suspected cholera was reported to have occurred at Raymond Street, Wapping, St. George's-in-the-East, in the person of a labourer, who had been employed on the SS. "Altmore," already referred to. Upon examination by the Port Medical Officer of Health, it was found that this man was suffering from diarrhœa, severe abdominal pain, and cramps in the legs. As the case was suspicious in character, the patient was at once removed to the Port Sanitary Authority's hospital, where he recovered. Work was stopped on board the "Altmore" and further disinfection carried out. No more cases were reported.

On August 2nd, the SS. "Dania" (8 hands), a vessel bound from Antwerp to Iceland, put into the Roads at Grimsby for the purpose of landing the engineer, who had been attacked on July 30th with symptoms

characteristic of cholera. The Port Medical Officer of Health after examination of the patient decided that he should be removed to the floating hospital of the Port Sanitary Authority; this, however, was not ready, and it was not until 1 p.m. on August 3rd that the removal could be effected. The patient died the same evening. The "Dania" was sent to the mooring station, and after disinfection, was allowed to proceed on her voyage to Iceland.

On August 2nd also, the schooner "Elizabeth McLea" (5 hands) arrived at Sheerness, Port of London, from Cherbourg, having left the latter port on July 31st. On her arrival it was reported that the mate, who had been on shore at Cherbourg, had sickened on August 1st with symptoms characteristic of cholera. He was removed to the Port Sanitary Authority's hospital, where in the end he recovered. Upon bacteriological examination of the dejecta of this patient by Dr. Macfadyen the presence of Koch's comma-bacillus was demonstrated. The vessel was sent to the mooring station for disinfection and no further cases were reported.

On August 23rd, at 1 a.m., the SS. "Mananeuse" (43 hands, 19 passengers) arrived at Liverpool from the Brazils *viâ* Lisbon and Havre, having left the two last-named ports on August 15th and August 20th respectively. On arrival it was reported that all on board were well, and the vessel entered the Brunswick Dock. At 4 p.m. a seaman on board was seized with vomiting, purging, and cramps in the belly and limbs. The Port Medical Officer of Health, on visiting the vessel, found that the patient had been removed to his house at 171, Grafton Street, Liverpool. He visited him there, and, regarding the case to be suspicious of cholera, caused his removal to the Park Hill Hospital, whence he was discharged cured on August 26th. The vessel was dealt with in the usual way, and no further cases were reported.

On September 18th the SS. "Glenmore" (23 hands) arrived at Southampton, having left Galatz on August 25th and Sulina on August 27th. Shortly after leaving the latter port several of the crew were reported to have suffered from severe diarrhœa; and upon medical inspection at Southampton a fireman who had been attacked on August 30th with characteristic choleraic symptoms was found to be still ill and very weak. He was accordingly at once removed to the Port Sanitary Authority's hospital, where he finally recovered. The "Glenmore" was thoroughly disinfected, and no further cases were reported.

On September 23rd the SS. "Ashbrook" (18 hands, 1 passenger) reached the Port of London from Cronstadt, having left the latter port on September 14th. Upon arrival it was ascertained that one of the crew, a "donkeyman," had sickened on September 17th with characteristic choleraic symptoms, and the Port Medical Officer of Health as the result of his personal examination of the patient was of opinion that he was suffering from Asiatic cholera. The patient was at once removed to the Port Sanitary Authority's hospital, where he died the same day. Upon bacteriological examination of some of the soiled linen belonging to the deceased, Dr. Macfadyen succeeded in demonstrating the presence of Koch's comma-bacilli. The "Ashbrook" was submitted to the usual disinfection, and after having discharged her cargo and taken in fresh water left the Port of London on September 30th for that of the River Blyth, in Northumberland.

App. A. No. 1.

On October 1st the SS. "Ashbrook," referred to in the last paragraph, arrived at the River Blyth Port, and it was then found that a man who had travelled in her from Cronstadt to London as a consular passenger, and who had joined the crew in London as a "coal trimmer," was, on arrival at the River Blyth, suffering from symptoms characteristic of cholera. The patient, who was in a state of collapse on arrival, had been attacked on the day (September 30th) the "Ashbrook" left London; he was at once, under instructions from the Port Medical Officer of Health, removed to the South Blyth Urban Sanitary Authority's hospital, where he died on October 2nd. The vessel was sent to the mooring station for disinfection, and no further cases were reported.

The master of the "Ashbrook" was prosecuted by the River Blyth Port Sanitary Authority on the ground that he, "being the master of a "ship called the 'Ashbrook,' then infected with cholera, did not, when "within three miles of the coast of England, to wit, Blyth, cause to be "hoisted the commercial code signal Q, being a yellow flag, under the "national ensign, and did not keep the same displayed during the hours "between sunrise and sunset on Sunday the 1st October" in accordance with the regulations contained in Section III. Article 19 of the Board's Cholera Order of 28th August 1890. The defendant was convicted and fined 10*l.* and 2*l.* 10*s.* 6*d.* costs.

The topographical situation of the ports at which cases of cholera "from foreign" were detected in 1893 is indicated in the annexed Map I.

In addition to the vessels named above, which were reported to have actually had cholera cases on board on their arrival, a number of vessels reached the ports of this country in 1893, as in the previous year, on which cases of cholera had occurred on the voyage. In all cases the usual procedure followed at English ports was carried out, the vessel in each instance being sent to the appointed mooring station for disinfection, and all persons on board, who, on medical examination were found to be free from suspicion of cholera, allowed to land at once upon furnishing the Port Medical Officer of Health with their names and addresses.

(*b.*) *Reputed Cholera among English Communities.*—I have already referred to the fact that in 1893 disease of the nature of cholera was reported to have appeared in England in 64 separate localities, and in the following pages I propose to give a detailed account of such of those appearances as were not the subject of special inquiry by one or another of the Board's medical staff, and with regard to which, detailed reports are included in this volume. In the latter class of cases short notes only of the outbreaks are given, the reader being referred for details to the complete reports. The topographical position of the several localities in which cholera was reported to have appeared in 1893 is shown in Map II.

In the following Table III. is shown the total number of attacks and of deaths referred to cholera in each locality where it was reported to have appeared in 1893. The rates of attack and of death per 10,000 of the population of the districts in which the cases occurred are also given.

Cholera in England and Wales 1893.

Map I.

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CHOLERA IN ENGLAND & WALES 1893.

Map II.

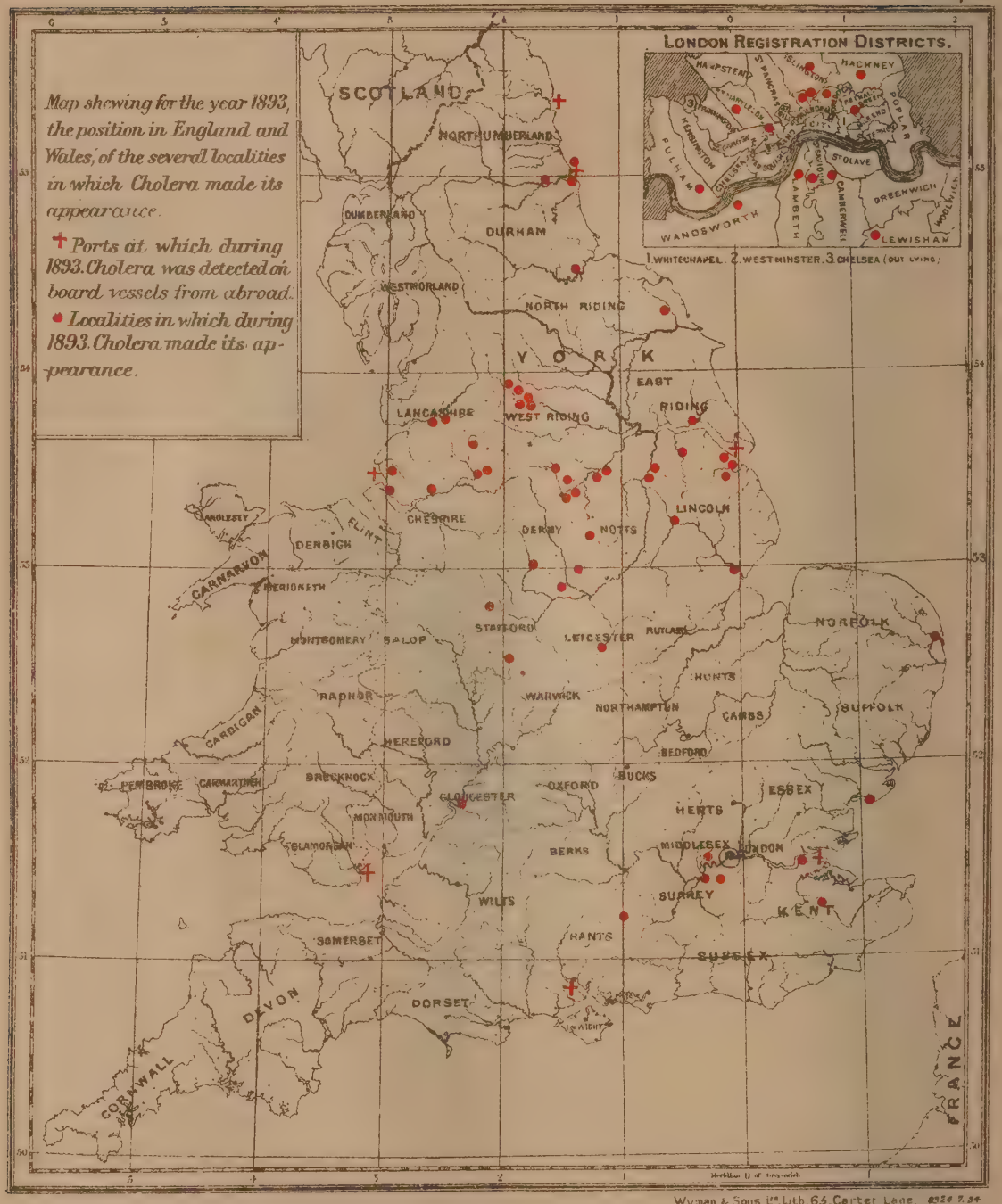

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Table III.

Showing the Number of Attacks and of Deaths referred to Cholera in English Communities in 1893.

[*In this Table rates taken on single attacks or single deaths respectively are placed in square brackets.*]

(*a.*) *In extra Metropolitan Districts.*

County.	Locality in which reputed Cholera appeared in 1893.	Population, Census 1891.	Date of onset of First Case reputed to be Cholera.	Total reputed Cholera		Rate, per 10,000 of Population. Cholera	
				Attacks.	Deaths.	Attacks.	Deaths.
Lincolnshire	Grimsby	51,934	9 Aug.	127	35	24·5	6·7
	Lincoln	41,491	9 „	1	1	[0·2]	[0·2]
	Cleethorpes	4,306	15 „	11	7	25·5	16·3
	Tetney (Louth R.)	775	2 Sept.	1	1	[129·0]	[129·0]
	Brigg	3,100	5 „	1	1	[33·4]	[33·4]
	Boston	14,593	6 „	1	1	[0·7]	[0·7]
	Morton (Gainsborough R.)	1,137	7 „	1	1	[8·8]	[8·8]
	Owston Ferry (Gainsborough R.)	1,294	13 „	1	1	[7·7]	[7·7]
Yorkshire	Kingston-upon-Hull	200,044	16 Aug.	17*	12*	0·8	0·6
	Rotherham	42,061	24 „	3†	2†	0·7	0·5
	Monk Bretton	3,426	2 Sept.	1	1	[2·9]	[2·9]
	Bradford	216,361	3 „	1	1	[0·05]	[0·05]
	Appleton-le-Street (Malton R.)	151	6 „	5	3	331·0	199·0
	Doncaster	25,933	7 „	1	1	[0·4]	[0·4]
	Handsworth	10,295	10 „	1	1	[1·0]	[1·0]
	North Bierley	22,178	18 „	7	6	3·2	2·7
	Idle	7,118	22 „	1	—	[1·4]	—
	Balby (Doncaster R.)	4,270	7 Oct.	2	1	4·7	[2·3]
	Rawmarsh	11,983	10 „	1	1	[0·8]	[0·8]
	Keighley	30,810	12 „	3	2	1·0	0·65
	Bingley	10,023	17 „	1	1	[1·0]	[1·0]
Lancashire	Middleton	22,162	4 Sept.	3	2	1·4	0·9
	Manchester	505,368	11 „	4	2	0·08	0·04
	Hurst	6,772	12 „	1	1	[1·5]	[1·5]
	Accrington	38,603	13 „	2	2	0·5	0·5
	Blackburn	120,064	17 „	1	1	[0·08]	[0·08]
	Liverpool	517,980	18 „	2	2	0·04	0·04
	Ormskirk	6,298	6 Oct.	1	1	[1·6]	[1·6]
	Warrington	52,743	13 „	1	1	[0·2]	[0·2]
Derbyshire	Ashbourne	3,809	6 Sept.	15	9	39·4	23·6
	Ilkeston	19,744	9 „	4	3	2·0	1·5
	Derby	94,146	14 „	1	1	[0·1]	[0·1]
Middlesex (extra Metropolitan.)	Willesden	61,265	7 „	1	1	[0·2]	[0·2]
Norfolk	Great Yarmouth	49,334	8 „	4	3	0·8	0·6

* In addition there were reported 152 cases of choleraic diarrhœa, of which 7 were fatal.
† In addition there were reported 18 cases of choleraic diarrhœa, of which 1 was fatal.

Counties.	Localities in which reputed Cholera appeared in 1893.	Population, Census 1891.	Date of onset of First Case reported to be Cholera.	Total reported Cholera. Attacks.	Total reported Cholera. Deaths.	Rate per 1000 of Population. Cholera. Attacks.	Rate per 1000 of Population. Cholera. Deaths.
Essex	Great Clacton	3,584	8 Sept.	11	1	3·07	0·28
Leicestershire	Leicester	174,624	9 „	1	1	0·00	0·00
Nottinghamshire	Mansfield	15,925	9 „	1	1	0·06	0·06
	East Retford	10,603	10 „	1	1	0·09	0·09
Durham	South Shields	78,391	10 „	2	2	0·02	0·02
	Newcastle-on-Tyne	49,705	14 „	1	1	0·02	0·02
Surrey (extra Metropolitan)	Mitcham (Croydon R.)	12,127	11 „	1	—	0·08	—
	Croydon	102,695	13 „	1	1	0·01	0·01
Northumberland.	River Tyne	—	17 „	1	1	—	—
	Newcastle-on-Tyne	186,300	20 „	4	2	0·02	0·01
Kent (extra Metropolitan)	West Malling (Malling R.)	2,254	24 „	1	1	0·44	0·44
Staffordshire	Rowley Regis	30,791	25 „	5	2	2·6	0·065
	Caton Hall Asylum	199	26 „	3	2	—	—
Hampshire	Crondall (Hartley, Wintney R.)	3,898	2 Oct.	6	—	15·4	—
Gloucestershire	Gloucester	39,444	3 „	1	1	0·02	0·02

(*b.*) *In Metropolitan Districts.*

—	Metropolitan Areas in which reputed Cholera appeared in 1893.	Population, Census 1891.	Date of onset of First Case reported to be Cholera.	Total reported Cholera. Attacks.	Total reported Cholera. Deaths.	Rate per 1000 of Population. Cholera. Attacks.	Rate per 1000 of Population. Cholera. Deaths.
Metropolitan Districts.	Shoreditch	124,009	18 Aug.	1	1	0·08	0·08
	St. Margaret and St. John the Evangelist, Westminster.	55,539	5 Sept.	1	1	0·2	0·2
	St. Marylebone	142,404	7 „	1	1	0·07	0·07
	Bethnal Green	129,132	8 „	1	1	0·08	0·08
	Clerkenwell	66,216	8 „	3	—	0·5	—
	Fulham	94,639	10 „	1	1	0·1	0·1
	Lambeth	275,203	10 „	1	1	0·04	0·04
	London Port	—	13 „	1	—	—	—
	Newington	115,804	14 „	1	1	0·08	0·08
	St. Luke	42,440	14 „	1	—	0·2	—
	Hackney	220,342	18 „	1	—	0·04	—
	Lewisham	92,647	20 „	1	—	0·1	—
	Islington	319,143	23 „	1	—	0·03	—
	St. George the Martyr, Southwark.	50,712	23 „	1	1	0·2	0·2
	Battersea	150,558	30 „	1	1	0·07	0·07

From the above table it will be seen that, although disease presumed to be cholera appeared in 64 towns, villages, or hamlets, in only 22 of the 64 did there occur plurality of cases. Further it appears that in not more than 5 of the 23 did the number of attacks exceed 10,

namely, in Grimsby, 127; Kingston-upon-Hull, 17; Ashbourne, 15; Cleethorpe-with-Thrunscoe, 11; and Great Clacton, 11.*

The total number of persons attacked with illness deemed to be of the nature of cholera in England in 1893 (exclusive of ship-borne cases), was 287, and of these 135, or 47 per cent., died.

In Table IV. the above cases and deaths are referred to the counties in which they occurred, and rates are taken in each instance on the total populations implicated. For England and Wales and for London, attack-rates and death-rates calculated, in each instance, on the total population, are appended to the Table.

TABLE IV.

SHOWING the NUMBER of ATTACKS and of DEATHS referred to CHOLERA in 1893 in the several COUNTIES of ENGLAND in which such CASES appeared.

[*In this Table, rates taken on single attacks or single deaths respectively are placed in square brackets.*]

County.	Date of Onset of First Case reputed to be Cholera.	Number of Localities where Disease appeared.	Population of Communities attacked (Census 1891).	Total reputed Cholera.		Rates per 10,000 of the Population.	
				Attacks.	Deaths.	Attacks.	Deaths.
Lincolnshire	9 Aug.	8	118,630	144	48	*12·1*	*4·0*
Yorkshire	16 „	13	584,653	44	32	*0·75*	*0·55*
Lancashire	4 Sept.	8	1,269,990	15	12	*0·1*	*0·09*
Derbyshire	6 „	3	117,699	20	13	*1·7*	*1·1*
Middlesex (extra-Metropolitan).	7 „	1	61,265	1	1	[*0·2*]	[*0·2*]
Norfolk	8 „	1	49,334	4	3	*0·8*	*0·6*
Essex	8 „	1	3,584	11	1	*30·7*	[*2·8*]
Leicestershire	9 „	1	174,624	1	1	[*0·06*]	[*0·06*]
Nottinghamshire	9 „	2	26,528	2	2	*0·75*	*0·75*
Durham	10 „	2	128,396	3	3	*0·2*	*0·2*
Surrey (extra-Metropolitan).	11 „	2	114,822	2	1	*0·1*	[*0·07*]
Northumberland	17 „	2	186,300	5	3	*0·3*	*0·2*
Kent (extra-Metropolitan)	24 „	1	2,254	1	1	[*4·4*]	[*4·4*]
Staffordshire	25 „	2	30,990	10	4	*3·2*	*1·3*
Hampshire	2 Oct.	1	3,898	6	—	*15·4*	—
Gloucestershire	3 „	1	39,444	1	1	[*0·2*]	[*0·2*]
Total extra-Metropolitan Districts		49	2,912,411	270	126	*0·9*	*0·43*
Metropolitan Districts	18 Aug.	15	1,893,979	17	9	*0·08*	*0·045*
Total England		64	4,806,390	287	135	*0·6*	*0·3*

RATES of REPUTED CHOLERA ATTACK and DEATH in 1893, calculated on the TOTAL POPULATION.

ENGLAND AND WALES	29,002,525	287	135	0·1	0·05
LONDON	4,211,743	17	9	0·04	0·002

* As regards Great Clacton it may be noted that, although included in the list, the outbreak possessed few of the characteristics of true cholera, as will be seen from a study of the details given at page 23.

Assuming that all the deaths referred to cholera were, as matter of fact, examples of that disease, comparison of the cholera mortality of England and Wales in 1893 with similar mortality in this country in 1848, 1849, 1853, 1854, 1865, and 1866, the only years in which cholera has appeared in this country since registration of deaths has been enforced, suffices to demonstrate the comparatively insignificant dimensions of the recent prevalence here of the malady.

Table V. makes such comparison, and shows that in 1893 the cholera death-rate of England and Wales was $\frac{1}{1000}$th, and the cholera death-rate of London was $\frac{1}{5000}$th, the corresponding rates recorded for 1866, the last occasion on which cholera was epidemic among our populations.

TABLE V.

MORTALITY STATISTICS of CHOLERA recorded in ENGLAND and WALES and in LONDON respectively in Years when CHOLERA has appeared in ENGLAND in Registration times.

Date.	England and Wales.		London.	
	Total Deaths.	Deaths per 10,000 Living.	Total Deaths.	Deaths per 10,000 Living.
1848	1,908	1·1	652	2·9
1849	53,293	30·3	14,137	61·8
1853	4,419	2·4	883	3·5
1854	20,097	10·9	10,738	42·8
1865	1,297	0·6	196	0·6
1866	14,378	6·8	5,596	19·4
1893	135*	0·05	9*	0·002

* These figures, it should be borne in mind, will not, having regard to the facts noted in paragraph 4, page 1, *post*, be found to correspond with the figures hereafter to be published by the Registrar General.

Before passing to the consideration in detail of the several cholera occurrences in this country during 1893, I submit Maps III.–VIII., showing the distribution in time of the observed cholera in 1893 throughout the country. Map III. deals with the period from the first appearance of cholera in 1893 to September 2nd; Maps IV., V., VI., and VII. with successive weeks in September; and Map VIII. with the period from October 1st to the end of the year.

GREAT GRIMSBY

On August 9th, a dock labourer, aged 49 years, living in Trinity Street, *Great Grimsby* (Lincolnshire), was attacked with choleraic illness, and died on August 11th, 40 hours after the onset of the disease. This death was certified as "cholera nostras." Between August 11th and August 30th 12 more fatal cases of a choleraic nature occurred in the town; of these 12 deaths, 3 were certified as from "diarrhœa," 6 as from "cholera nostras," 2 as from "English cholera," and 1 as from "choleraic diarrhœa." In consequence of the reported occurrence of these suspicious cases, Dr. Reece was sent to Grimsby on August 29th, to make inquiry into the matter on behalf of the Board. In the case of two further deaths, which took place on August 30th and 31st respectively, after similar illnesses to those observed in the earlier cases, samples of the bowels and dejecta of the patients were forwarded to Dr. Klein for bacteriological examination

(*see* Appendix B., page 177, Materials II. and III.). Dr. Klein reported in both cases that the results obtained were indicative of true cholera. The prevalence of choleraic illness persisted in Grimsby until October 14th. During the whole period, from August 5th to October 14th, 127 persons were reported to have been attacked at Grimsby with illness of the nature of cholera, and in 35 instances fatal results followed. During the same period, in addition to these cases, which in the majority of instances must be regarded as true cholera, a large number of persons were reported to have suffered from diarrhœa, which proved fatal in 81 instances. Many of the "diarrhœa" cases are said to have been "infective," and to have had symptoms somewhat suspicious of cholera. As regards two of the "diarrhœa" cases, samples of the dejecta were submitted to Dr. Klein for bacteriological examination (*see* Appendix B., page 185, Materials XLVI. and XLVII.). In both these cases Dr. Klein reported that the results of his examinations were negative as regards the presence of Koch's comma bacillus.

App. A. No. 1. On Cholera in England and Wales in 1893: by Dr. Barry.

Dr. Reece's detailed report of his inquiry into the circumstances of the outbreak at Great Grimsby, will be found in Appendix A., No. 2, page 47.

Lincoln.

On August 9th, a person residing at *Lincoln* (Lincolnshire) was attacked with symptoms suspicious of cholera. The history of the case, as obtained from local sources, may be summarised as follows:—H. B., female, aged 36 years, living in Ripon Street, Lincoln, a delicate woman subject to attacks of diarrhœa, went on July 29th to Cleethorpes and Grimsby and returned to Lincoln on August 5th apparently quite well. On August 8th she again went with a friend to Cleethorpes by a trip, returning the same night. On August 9th she was attacked with vomiting and diarrhœa, pain in the abdomen, and cramps. The evacuations are stated to have been watery and greenish yellow in colour. The urine, though not suppressed, was stated to have been small in quantity. The patient continued ill on August 10th and died on August 11th. The friend who was with her at Cleethorpes did not suffer from diarrhœa. The deceased is stated to have been fond of oysters, and to have brought some home with her on August 8th. Precautions as to disinfection of drains, &c., are said to have been taken, and no further cases were reported from Lincoln. The occurrence of this case was not reported to the Board by the local authorities, the first intimation of its having taken place being received on September 1st from the Board's inspector, Dr. Reece, who was at that time making inquiry as to the outbreak of cholera at Grimsby and who heard of it there. Efforts to obtain more complete details have failed.

Cleethorpe-with-Thrunscoe.

On August 15th, the first reported case of a series of eleven attacks of choleraic illness, of which seven proved fatal, occurred at *Cleethorpe-with-Thrunscoe* (Lincolnshire), a sanitary district adjoining Grimsby. This outbreak was investigated by Dr. Reece, whose detailed report will be found in Appendix A., No. 2, page 47. All the attacks occurred in the period August 15th—September 8th. Bacteriological examination was not made with respect to any of the cases at Cleethorpes but the clinical history of the persons attacked was consistent with that of true cholera.

Kingston-upon-Hull.

On August 16th, a man aged 61 years, living in a common lodging-house at *Kingston-upon-Hull* (Yorkshire), was attacked with choleraic symptoms, from which, however, he recovered. On August 24th, a boy, aged 11 years, residing in a house situate in the same quarter of the town as the patient referred to above, was attacked with suspicious

symptoms, and died the same day after an illness of under ten hours. A piece of the ileum of this patient was forwarded to Dr. Klein for bacteriological examination (*see* Appendix B., page 176, Material I.). Dr. Klein reported as the result of his examination that the appearances were typical of true cholera. Subsequently, between August 24th and October 12th, 168 cases of a choleraic nature (16 certified as "cholera" and 152 as "choleraic diarrhœa") were reported of which 16 died (11 "cholera" and 5 "choleraic diarrhœa"). As regards another of the fatal cases certified to be due to "cholera," a piece of ileum was examined bacteriologically by Dr. Klein (*see* Appendix B., page 177, Material IV.), and here, as in the first case examined, Dr. Klein reported that the appearances were typical of true cholera. The circumstances of this outbreak were made the subject of a special inquiry on behalf of the Board by Dr. Theodore Thomson, whose detailed report will be found in Appendix A., No. 3, page 89.

SHOREDITCH.

On August 19th, a telegram was received by the Board from the Vestry Clerk of *Shoreditch* (London) that a death from "cholera" had been notified there that day. This being the first case of cholera reported as occurring in any Metropolitan District in 1893, Dr. Horne, one of the Board's medical inspectors, was instructed to inquire into the circumstances of the case. He reported the case to be that of G. F. H., male, aged 10½ years, residing in Wimbourne Street, Hoxton, Shoreditch. He was a sturdy, healthy child, and had been apparently in perfect health until August 18th. In the morning of that day he had tea and bread and butter for breakfast. After being out at play most of the morning he went home to dinner, which meal consisted of pease pudding and bread. About 2 p.m. he went for a ride in a covered van with a friend of his father's and another boy, who were engaged in delivering parcels of woollen goods in the City. He remained with them until about 6 p.m. About 5 p.m., while in the van, he complained of feeling unwell, and had an attack of vomiting. On reaching home he was at once attacked with purging and vomiting, and complained of great pain in the chest and abdomen. Medical aid was obtained between 7 and 8 p.m. The medical man who was called in stated that he found the patient lying upon his side with his lower limbs drawn up, in a state of collapse and semi-consciousness. He resented being touched, and groaned loudly, as though in great agony. The surface of his body was cold, and his face was livid and "drawn." He discharged copious "rice-water" evacuations from the bowels at 8.30 p.m. On August 19th, the patient was stated to have been quite unconscious, cold and livid, with his limbs "drawn up with cramps more than on the previous night." He died in this condition about 9.30 a.m. A post-mortem examination was made at 4 p.m. on August 19th, with the following results:—The body, which was well nourished, was not quite cold; rigor mortis was incomplete; the face had a pinched appearance, and the lips and nose were dark; on turning the head on one side a little yellowish fluid trickled from the mouth; hypostatic staining was well marked over the back and dependent parts; the thoracic organs were apparently normal; no pathological change was observed on the external surfaces of the stomach and intestines. The stomach contained about an ounce of pultaceous bile-stained liquid; the mucous membrane was slightly swollen, and at the cardiac end there were vascular streaks, which were most marked on the lesser curvature. The intestines were not opened. The stomach and intestines, together with portions of other organs, were reserved for detailed examination, which, however, was not made, owing to the fact that these organs were detained by the

Coroner until decomposition had become advanced. No evidence could be obtained of the deceased having associated prior to his illness with any person who had come from a cholera-infected place, nor of his having eaten any food from abroad, nor of the occurrence of any similar illness among the neighbours in the street where deceased had lived.

On August 22nd the death of a man at Singleton Street, Shoreditch, was notified to the Board as "probably due to cholera," and Dr. Horne was consequently directed to make inquiry into the circumstances of the case. After careful consideration of the clinical history and of the results of a post-mortem examination, Dr. Horne reported that in his opinion the disease was not cholera. No further cases were reported from the district.

Rotherham.

On August 24th a woman, aged 29 years, residing at *Rotherham* (Yorkshire), died after a few hours' illness, the symptoms of which are stated to have been abdominal pains and collapse, without sickness or diarrhœa. This woman had, with several friends, spent the preceding day (August 23rd) at Grimsby and Cleethorpes, where cholera was then occurring. Of the party she alone had eaten oysters on the sands at Cleethorpes. On September 5th a collier, aged 31 years, residing in a house about 800 yards distant from that occupied by the patient referred to above, was attacked with choleraic symptoms and died the same day. A portion of the ileum of this patient was forwarded to Dr. Klein for bacteriological examination (*see* Appendix B., page 177, Material V.). As a result of his examination Dr. Klein reported the presence of Koch's comma-bacillus. Subsequently, between September 11th and October 18th, 20 cases of a choleraic nature (2 certified as "cholera" and 18 as "choleraic diarrhœa") were reported, of which 2 proved fatal (1 "cholera," 1 "choleraic diarrhœa"). As regards two of the cases certified as "choleraic diarrhœa," bacteriological examination was made of the stools by Dr. Sims Woodhead, and in both instances the results were stated to be indistinguishable from true cholera. The circumstances of this outbreak were made the subject of a special inquiry on behalf of the Board by Dr. Theodore Thomson, whose detailed report will be found in Appendix A., No. 4, page 109.

Monk Bretton.

On September 2nd a person residing at *Monk Bretton* (Yorkshire) was attacked with choleraic symptoms early in the morning and died on the evening of the same day. The history supplied by the medical attendant (Mr. M. C. Sykes) was as follows:—M. S., female, aged 65 years, married, living at Hill Top, Monk Bretton, was attacked about 5.30 a.m. on September 2nd with vomiting and diarrhœa, followed by cramps in the limbs. The patient was first seen by her medical attendant about 9.30 a.m.; at that time she was suffering from severe abdominal pain, not relieved by pressure; cramps in the legs, feet, abdomen, and thighs; cold hands, feet, and face; cyanosis; cold perspiration standing in drops on face and head; shallow breathing; abdomen retracted; total suppression of urine; persistent purging and vomiting; motions "rice water" in character; vomiting of watery fluid; mind clear; temperature in axilla, subnormal; pulse imperceptible at the wrist, ankles, and temporals; voice reduced to whisper; great thirst; patient in state of general collapse. At 7.45 p.m. the patient was in a condition of extreme collapse; feet and hands markedly contracted and claw-like. She died at 8.45 p.m. No post-mortem or bacteriological examination was made in this case. The patient is stated to have been staying at Cleethorpes shortly before her attack, but the exact date is not known. Measures of disinfection were taken and no further cases were reported.

App. A. No. 1.

Epidemic in England and Wales in 1893; by Dr. Barry.

Tetney. [Louth Rural District.]

On September 2nd, a woman aged 71 years, residing at *Tetney* in the Louth Rural Sanitary District (Lincolnshire), who had been suffering from slight diarrhœa for some months, was attacked with symptoms suspicious of cholera. On September 3rd purging was stated to have been persistent, with motions having the appearance of "curds of milk "floating in water." The purging was accompanied by cramps in the legs, coldness of surface, husky voice and great thirst. She was first seen by a medical man at 11 a.m., September 4th, when she was in a state of pronounced collapse; temperature 97° Fahr.; extremities cold; pulse at wrist almost imperceptible; and she died at 4 p.m. on that day. No post-mortem or bacteriological examination was made in this case. Dr. Domenichetti, the Medical Officer of Health, who had had large experience of cholera in India, regarded the case to be true cholera. The patient had not been from home for six months prior to the onset of the choleraic symptoms; but a daughter-in-law, who lived with her, had, it is stated, three weeks previously, nursed a patient at Grimsby suffering from "choleraic diarrhœa." Special precautions in the direction of prompt interment of the corpse, destruction of all clothing, &c., likely to be infected, and disinfection were carried out and no further suspicious case occurred in the district.

Bradford.

On September 3rd an attack suspected to be cholera occurred at *Bradford* (Yorkshire), which proved fatal on September 4th. The facts of the case as supplied by the Medical Officer of Health are as follows:—J. D. W., male, aged 47 years, living in Wakefield Road, Bradford, was attacked with diarrhœa at 5 a.m. on September 3rd. The patient complained of abdominal pain, which persisted until death; there was, however, no vomiting. The diarrhœa became worse, and was accompanied by cramps; the patient finally became collapsed, and died at 1 a.m. on September 4th. No post-mortem examination was made. The Medical Officer of Health found in the patient's house a bucket of mussels, the remainder of a large quantity purchased from a wholesale dealer in Bradford on September 2nd. The dealer from whom the mussels were obtained was unable to state the source of this particular batch, as he stated he had lately received consignments from several places. This stock had become mixed up; some, however, had been received from Grimsby and Cleethorpes. There was no evidence to show that the deceased had eaten any of the mussels prior to his attack. The usual precautions as to disinfection were taken, and no further cases were reported.

Middleton.

On September 4th a woman, aged 64 years, living at the Old Hall Inn, *Middleton* (Lancashire), was attacked with choleraic illness, which proved fatal on September 5th, 14 hours after the onset of the symptoms. A second woman (aged 70 years), who had been in communication with the case noted above, was attacked with similar symptoms on September 6th, and died after 12 hours illness, on September 7th. A third woman (aged 44 years), who had been in attendance on the second patient, was on September 8th seized with choleraic illness, from which she subsequently recovered. In all these cases the clinical history was consistent with that of true cholera. No post-mortem or bacteriological examinations were made with regard to any of the cases.

Dr. Sweeting made inquiry into the circumstances of the outbreak on behalf of the Board, (*see* Appendix A., No. 5, page 119.) It was not found possible to trace any connexion between the first of these cases and any cholera infected person or place. Measures of disinfection were carried out, and no further cases were reported from Middleton in 1893.

Brigg.

On September 5th a person resident at *Brigg* (Lincolnshire), who had been suffering from slight diarrhœa for some days, was attacked with violent purging and vomiting accompanied with cramps in the lower extremities; stools and vomited matter were "rice water" in character; temperature, 96° Fahr.; pulse, 150. Subsequently the bowels were moved every few minutes, and all matters taken in by the mouth were at once rejected. The voice sunk to a hoarse whisper. Finally, the urine was suppressed, and the patient became comatose, dying on September 8th, after three days' illness. No post-mortem examination was made, and some of the discharges from the bowels forwarded to Dr. Klein for bacteriological examination were found to be unsuitable for the purpose.

Westminster.

On September 5th one of the cleaners of the House of Commons, residing at Marsham Street, *Westminster* (London), was attacked with symptoms suspicious of cholera, which proved fatal on September 7th. Dr. Sweeting was instructed to make inquiry as to the circumstances of the case (*see* Appendix A., No. 6, page 123). A piece of the ileum of the deceased, together with some of the "rice-water" dejecta, was sent to Dr. Klein for bacteriological examination (*see* Appendix B., page 177, Material VI.). Dr. Klein reported the results of his examination to be typical of Asiatic cholera.

On September 20th the death of another cleaner of the House of Commons was reported to have taken place under circumstances suspicious of cholera, and Dr. Sweeting was consequently directed to make inquiry respecting it. From his report, however, it appeared that in this case the death had been caused by peritonitis, due to a strangulated intra-abdominal hernia, and that there was no evidence whatever of cholera.

On October 16th the death of a woman residing in Great Peter Street, Westminster, who had not been seen prior to her death by a medical man, was the subject of a coroner's inquest, and in consequence of the evidence of the medical practitioner who had made a post-mortem examination of the body, to the effect that death might have arisen from cholera, the jury expressed a hope that a bacteriological examination would be made. A portion of her ileum was accordingly sent to Dr. Klein by the Medical Officer of Health to the London County Council, and Dr. Klein reported that the piece of ileum "was much congested and "contained brownish blood-stained fluid. No definite commas amongst "crowds of bacteria. Cultivations entirely negative quâ comma-"bacilli." Such clinical history as could be obtained gave no grounds for suspicion of cholera.

Boston.

On September 6th, a female, aged 47 years, resident at *Boston* (Lincolnshire), was attacked by diarrhœa. She was seen by her medical attendant (Mr. W. J. Pilcher) at 5 p.m., when the diarrhœa was slight; at 9.30 p.m. she had violent cramps in the legs and abdomen; "rice water" discharges from the stomach and bowels; blueness of skin and impending collapse. The attack proved fatal about 4 a.m. on September 7th. In view of the symptoms and the rapidly fatal results, Mr. Pilcher, with the concurrence of the Medical Officer of Health, forwarded a portion of the colon and some of the discharges to Dr. Klein for bacteriological examination (*see* Appendix B., page 178, Material IX.). From the results of his examination Dr. Klein reported that the cultivations were typical of Asiatic cholera. No source of infection could be traced. The deceased had come from Manchester to Boston some weeks before her attack, and had not since left the town. She is stated to have been indulging heavily in alcohol prior to her attack.

On September 6th the first of a series of fifteen attacks of choleraic illness, of which nine proved fatal, occurred at [illegible]. This outbreak was investigated by Dr. Bruce Low, whose detailed report will be found in Appendix A., No. 8, page 127. All the attacks occurred in the seven days ending September 12th. A piece of the ileum of one of the fatal cases was sent to Dr. Klein for bacteriological examination (*see* Appendix B., page 180, Material XVIII.). Dr. Klein reported the results of his examination to be indicative of true cholera. The dissemination of the disease was attributed to the use of polluted well water, but the source of the cholera remained, as will be seen from Dr. Low's report, obscure.

Appleton-le-Street.

On September 6th, a man aged 28 years, on his return home to *Appleton-le-Street*, in the Malton Rural Sanitary District (Yorkshire), from Scarborough, was attacked with symptoms of a choleraic nature, and died early on September 10th. Subsequently between September 12th and September 20th four other persons, relatives of deceased, and who had either stayed in the house at Appleton-le-Street or had visited there, were attacked with a similar illness, and of these four persons, two, aged 70 and 27 years respectively, died. A sample of the dejecta and a portion of the ileum of the second and third persons respectively fatally attacked were forwarded to Dr. Klein for bacteriological examination (*see* Appendix B., page 182, Materials XXXIV. and XXXIII.). Klein reported that as regards the stool, although the microscopical examination gave suspicious results, the cultivations proved negative with respect to the presence of comma-bacilli. The results of the examination of the portion of ileum were, however, typical of true cholera. A sample of one of the stools passed on the fifth day of illness in the case of one of the patients who recovered, was also forwarded to Dr. Klein for bacteriological examination (*see* Appendix B., page 183, Material XXXVII.). In this case Dr. Klein, on making a microscopical examination, detected the presence of some suspicious looking curved bacilli, but the cultivations all remained sterile, a result probably due to the "disinfection" of the stool prior to its despatch to him. The circumstances of this outbreak were made the subject of a special inquiry by Dr. Copeman on behalf of the Board, and his detailed report will be found in Appendix A., No. 9, page 132.

St. Marylebone.

On September 6th a case notified to be "cholera" occurred in *St. Marylebone* (London). No medical man was called in until about an hour before the patient's death, which took place on September 6th, at about 8 p.m. An inquest was accordingly held, when the following facts were obtained as to the history of the case:—J. E., male, aged 12 years, residing at Elgin House, Horace Street, Marylebone, was stated to have been in good health and to have attended school on September 5th. About midnight he had an attack of vomiting, but slept well until 7 a.m. on September 6th, when he was again seized with vomiting, accompanied by diarrhœa, which persisted throughout the day, and a medical man was called in about 7 p.m., when he found the child in a state of collapse, death taking place about three quarters of an hour afterwards. At the post-mortem examination the stomach was found to be somewhat congested at the great curvature, and to be full of food, chiefly consisting of curdled milk; the intestines generally were stated to have been much congested, and a small portion of the ileum to have been intensely congested. The small intestine contained matters tinged with bile, and the large intestine liquid matter also tinged with bile. Portions of the contents of the stomach and intestines were forwarded

to the College of State Medicine for bacteriological examination, but the cultivations were stated to have yielded negative results as regards the presence of comma-bacilli. No history of exposure to infection could be obtained and no further cases were reported.

Willesden.

On September 7th, a man arrived at *Willesden* (Middlesex) from Cleethorpes suffering from diarrhœa, which had commenced whilst at Cleethorpes on September 5th. The history supplied by Dr. Bathis, the medical attendant, is as follows:—M. E., male, aged 60 years, residing in High Street, Harlesden, Willesden, had been attacked on September 5th when at Cleethorpes with diarrhœa. On September 7th he travelled from Cleethorpes to Willesden, *viâ* King's Cross; on September 8th, he had from 15 to 20 motions of the bowels; on September 9th, at 6.45 p.m., he was first seen by Dr. Bathis, and was then suffering from slight diarrhœa, vomiting, and cramps; temperature in mouth, 95·6° Fahr., in axilla, 95° Fahr.; on the morning of September 10th temperature in axilla, 95·8° Fahr.; patient had evacuated bowels three times, and had vomited twice during the night, the cramps still continued slightly, patient much better. Some of the bowel evacuations were sent to Dr. Klein for bacteriological examination (*see* Appendix B., page 179, Material XI.), who reported that his cultivations proved negative as regards the presence of Koch's comma-bacillus.

Doncaster.

On September 7th a person travelling by rail from Leeds to *Doncaster* (Yorkshire) was attacked on his arrival at the latter place with choleraic symptoms and died the same day. The history of the case as supplied by the Medical Officer of Health and the House Surgeon of the Doncaster Infirmary is as follows:—R. P. H., male, aged 45 years, publican, residing at the Abercrombie Inn, Burmantofts, Leeds, travelled on September 7th from Leeds to Doncaster; the patient began to feel ill in the train when only halfway to Doncaster. On arrival at Doncaster Station about noon he complained of great pain in the bowels, and was sick and purged. Under medical advice he was removed to the Doncaster General Infirmary. Upon admission into the Infirmary at 1.30 p.m. he was in a state of extreme collapse; pulse at wrist almost imperceptible; hands, feet, and legs cold, but trunk warm; face cold and dusky, covered with a profuse cold perspiration; eyes sunken; pupils equal, but somewhat contracted; voice scarcely above a whisper; cramps in thighs, calves, feet, and hands; severe abdominal pain. There was no purging after his admission to hospital, and he only vomited once. The patient gradually sank and died at 5.15 p.m. Rigor mortis came on very quickly, commencing within a few minutes after death. A post-mortem examination was made the same evening, when the following conditions were observed:—Intestines fairly distended, filling the abdominal cavity; portions of the bowels had a faint rosy tint on their serous aspect; the contents consisted of a thin, whitish, opaque fluid; lungs shrivelled, dry, and tough; spleen contracted and leathery; heart normal, but contracted and empty; blood dark coloured and thick; other organs apparently normal. A portion of the ileum was forwarded to Dr. Klein for bacteriological examination (*see* Appendix B., page 178, Material VIII.). Dr. Klein reported that although on microscopical examination there was evidence of the presence of comma-shaped organisms, the cultivations all proved sterile, a result evidently due to the fact that spirits had been added to the specimen of bowel.

It appeared that the patient had been ailing for several months prior to his attack. About the end of July he had suffered when at Morecambe from an attack of diarrhœa. Between 9.30 a.m. and 10 a.m.

on September 7th, previous to his leaving Leeds for Doncaster, he went to a fish-shop and ate some oysters, which had come from Cleethorpes. He had not been from Leeds for some time previous to September 7th. The usual precautions as to disinfection were taken at Doncaster, and no further cases were reported.

Morton. [Gainsborough Rural District.]

On September 7th a resident in the village of *Morton*, in the Gainsborough Rural Sanitary District (Lincolnshire), was attacked with choleraic symptoms, which proved fatal on September 8th, after 19 hours' illness. Dr. Bruce Low was instructed to investigate the circumstances of the case, and his detailed report will be found in Appendix A., No. 10, page 136. Portions of the ileum and colon of this person were forwarded to Dr. Klein for bacteriological examination (*see* Appendix B., page 179, Material X.). Dr. Klein reported the result of his examination to be typical of cholera.

Bethnal Green.

On September 8th a case of reputed cholera occurred at *Bethnal Green* (London), which proved fatal on September 9th. The following is the history so far as could be obtained from local sources:—J.A., female, aged 20 years, residing in Treadway Street, Bethnal Green, on September 7th ate a dozen oysters for supper; on the following day (September 8th) she suffered from slight diarrhœa. On September 9th, at 8 a.m., she was attacked with violent vomiting and purging, accompanied with general cramps "all over her." At 11 a.m. she was stated to have been cold and clammy, and at 5 p.m. to have been in a state of collapse; she died at 10 p.m. There was no history of exposure to infection to be obtained; the deceased had prior to her attack been nursing her mother, who was "out of sorts," but who had not suffered from diarrhœa. No post-mortem or bacteriological examination was made in this case.

Great Yarmouth.

On September 8th, an itinerant watercress seller living at a common lodging-house in *Great Yarmouth* (Norfolk), was attacked with severe diarrhœa and cramps, and was in consequence removed to the Borough Hospital, where he speedily recovered. On September 18th, a female adult living at Yarmouth was seized with choleraic symptoms and died on September 20th. In neither of these cases was any post-mortem or bacteriological examination made. On September 21st, a boy, aged 13 years, was attacked with choleraic illness, which proved fatal the following day, September 22nd. A portion of the ileum of this patient was forwarded to Dr. Klein for bacteriological examination (*see* Appendix B., page 182, Material XXXVI.) Dr. Klein reported the results of his examination to be characteristic of true cholera. On September 28th, a fourth attack of the nature of cholera occurred at Yarmouth in the person of a girl aged 9 years; in this instance a sample of one of the "rice-water stools" was forwarded to Dr. Klein for bacteriological examination (*see* Appendix B., page 183, Material XL.). Dr. Klein reported the stool to be "a pure cultivation of Koch's cholera commas." The child died about eight days after the onset of the disease. The circumstances of these cases at Yarmouth were made the subject of a special inquiry by Dr. Copeman on behalf of the Board, and his detailed report will be found in Appendix A., No. 11, page 140.

Clerkenwell.

On September 8th a person residing in *Clerkenwell* (London) who had been attacked on that day with symptoms suspicious of cholera was admitted to St. Bartholomew's Hospital. The history of the case, as summarised from the hospital records, is as follows:—H. T., male, aged 24 years, printer, living at Chapel Street, Clerkenwell. At 8 a.m.

on September 8th attacked with diarrhœa, at 9.45 began to vomit; at 10 a.m. cramps in the legs commenced, and at 11.45 the cramps extended to the arms; at noon he was admitted to St. Bartholomew's Hospital, his bowels having been opened twelve times in the four hours prior to his admission. Upon admission his condition was one of extreme collapse; eyes sunken; face livid; tongue dry, covered with brown fur; speech husky; mental condition unimpaired; much cyanosis of whole body; pulse 130, almost imperceptible, but apparently regular; temperature 96·2° Fahr. in the axilla, and 100·4° Fahr. in the rectum; respirations 18; the abdomen was retracted, but there was no tenderness, and no dulness in the hypogastric region; extremities cold and cyanosed; frequent cramps, causing severe pain in the upper and lower extremities; no abdominal cramp; stools watery, very light yellow in colour containing no fœcal matter, very offensive; suppression of urine, less than half an ounce having been passed in 24 hours. At 5.35 p.m. patient vomited matter "rice water" in character; at 10.45 p.m. passed "rice-water" stool; urine, three drachms, contained albumen; temperature at 7 p.m. 96·8° Fahr. The patient passed a restless night, but on the morning of September 9th his general condition was much improved; less cyanosis; pulse 92, better volume and tension; bowels opened three times, stools "rice water" in character; urine 13 ounces, contained trace of albumen; no vomiting; temperature, morning, 99·2° Fahr., evening 97·4° Fahr. On September 10th, improvement in general condition continued; bowels opened twice, stools "rice water" in character, but containing a slight amount of fœcal matter; no cyanosis; pulse 80; urine 33 ounces; temperature, morning, 96·4° Fahr., evening 98·8° Fahr. On September 11th patient complained of rheumatic pains in his shoulders; semi-solid stool, light in colour; urine contained trace of albumen; temperature, morning 98·2° Fahr., evening 100° Fahr. September 13th: solid stool, light brown; urine not albuminous September 19th: temperature normal; patient convalescent; he was discharged cured on September 26th. A portion of one of the "rice-water" stools passed on September 9th was forwarded to Dr. Klein for bacteriological examination (*see* Appendix B., page 178, Material VII.). Dr. Klein reported that whilst from the microscopical examination there was some suspicion of the presence of comma-bacilli, cultivations proved negative as to Koch's commas. No evidence could be obtained of the patient having, previous to his attack, had contact with any persons suffering from similar illness. He was stated to be a man of somewhat intemperate habits; on the day, September 7th, prior to his attack he had been at his work, in the evening he had drunk six pints of beer and eaten an egg, a sandwich and some fried plaice, the beer and the fish both being stated to be of doubtful quality.

On September 17th a youth residing also in *Clerkenwell* was attacked with choleraic symptoms, and was admitted the same day to St. Bartholomew's Hospital. The patient was there seen on behalf of the Board by Dr. Copeman, and the following history has been compiled partly from Dr. Copeman's memorandum, partly from the hospital records:—J. E. F., male, aged 11 years, living in Little Sutton Street, Clerkenwell, was apparently quite well until at 4.30 p.m. when leaving church on September 17th he was suddenly seized in the street with pains in the abdomen, vomiting, and diarrhœa, and his legs gave way and he fell down. He was admitted to hospital at 7.45 p.m. On admission he was very collapsed; face pinched and sallow; pulse imperceptible at wrist; eyes sunken; voice a mere whisper; much thirst; vomiting a quantity of watery material, which on standing deposited a flocculent

sediment; bowels opened immediately after admission; motion watery, opalescent, with slight pink tinge; no cramps; urine suppressed; temperature 99·6° Fahr. He vomited several times during the night and passed watery motions in bed. On September 18th urine still suppressed, bladder not distended; abdomen retracted; general condition of patient improved; pulse still small but regular; vomiting ceased; in evening bowels opened, motion watery, opalescent with flocculent sediment; temperature, morning, 97·8° Fahr., evening 97·8° Fahr. On September 19th the patient passed urine for the first time 30 hours after admission; the general improvement in his condition was maintained, and the patient gradually recovered and was discharged cured on September 27th. His temperature remained subnormal until he left the hospital. Samples of the stools passed by the patient on September 17th and 18th were forwarded to Dr. Klein for bacteriological examination (*see* Appendix B., page 181. Material XXVI.). Dr. Klein reported the results of his examination to be negative as regarded the presence of comma bacilli. As regards the history of this patient prior to attack, it appears that whilst on September 17th his dinner consisted of three or four ginger nuts and an orange, he had on the evening of September 16th, together with his brother, eaten some fried fish and potatoes, obtained ready cooked at a shop in Goswell Road. This fish was stated to have been obtained from Grimsby. After eating the fish the brother of the patient was attacked with vomiting, but recovered.

On September 19th another boy residing in the same block of houses in *Clerkenwell*, as the case of J. E. F. referred to above, was attacked with symptoms somewhat suspicious of cholera, and was admitted into St. Bartholomew's Hospital. The history of the case, as obtained from notes supplied by the Medical Officer of Health of the London County Council, and from the hospital records, is as follows:—S. F., male, aged 6½ years, living in Little Sutton Street, Clerkenwell, was attacked at 8.30 p.m. on September 19th, with vomiting and purging, the motions being very profuse and watery. He was admitted to hospital about 11.30 the same evening, and was purged and vomited in the surgery. On admission to the wards the vomiting persisted; the material brought up consisted of mucus with a little frothy secretion, and was on one or two occasions streaked with blood; purging occurred immediately after admission; motions very loose, but somewhat darker in colour than those passed in the surgery; urine suppressed; temperature, 99° Fahr.; pulse feeble; face pinched. On September 20th the diarrhœa ceased, and the patient began steadily to improve; temperature, morning, 96·6° Fahr., evening, 97° Fahr. On September 21st the patient passed urine (11 ounces) for the first time since his admission to hospital. He was discharged cured on September 27th. His temperature remained sub-normal until he left. No bacteriological examination was made in this case. With regard to the history of the patient prior to attack, it is interesting to note that on September 18th he had eaten some fried plaice obtained from the same shop in Goswell Road as that referred to in the case of J. E. F. noted above. This shop had a notice in the window "Fresh fish from Grimsby daily."

The only other case of illness occurring in the Clerkenwell district during 1893 in which there was any suspicion of cholera was that of a girl residing at Merlin Place, who died on October 23rd, after having suffered from symptoms which were by no means free from doubt. Upon post-mortem examination, however, it was apparent that the patient had died from peritonitis, and not from cholera. The following notes on

this case were supplied by the Medical Officer of Health of the London County Council:—

"E. O., female, aged 14 years, book folder, Merlins Place, Clerkenwell. October 20th, pain in abdomen and shivering came on, followed by frequent vomiting. On 21st the vomiting continued, and was accompanied by diarrhœa. Motions light-coloured. On the 22nd, delirious, still vomiting. On 23rd, patient was admitted into St. Bartholomew's Hospital. Patient was then collapsed, with cold extremities. Died same night. A post-mortem examination was made, and there was found to be intense purulent peritonitis. There was no lesion visible to the naked eye to account for this. A portion of the ileum and of the peritoneal fluid was given to Dr. Klein. Report by Dr. Klein:—In the peritoneal turbid fluid, and in the solid masses of lymph, numerous cocci—in clumps, and as diplo-cocci—could be distinguished. The whole of the intestine was congested, and in its cavity solid lumps of lymph containing the same masses of cocci. No comma-bacilli could be found. Cultivations proved negative quâ comma-bacilli."

Mansfield.

On September 8th a woman, aged 46 years, living in Stockwellgate, *Mansfield* (Nottinghamshire), was seized with symptoms stated to have been choleraic in character, accompanied with suppression of urine, and followed by collapse, death occurring 96 hours after seizure. The patient's medical attendant, who is said to have had experience of cholera abroad, regarded the case as one of undoubted Asiatic cholera. A sample of a stool passed on September 12th, was forwarded to Dr. Klein for bacteriological examination (*see* Appendix B., page 180., Material XX.). Dr. Klein reported the appearance of some suspicious comma-shaped bacilli on microscopical examination, but the results of his cultivations were negative as regards the presence of Koch's commas. Two cultures of material made on the spot by Mr. C. Wills, the Medical Officer of Health, and forwarded to Dr. Klein, were found to consist entirely of bacillus coli. The patient, who was the wife of a greengrocer in Mansfield, is stated to have been very fond of oysters, of which she obtained a quantity on September 4th, four days before the commencement of her illness. All necessary precautions as to disinfection, &c., were taken, and no further cases were reported from the district.

Great Clacton.

On September 9th, about midnight, T. P., female, aged 6 years, residing at "The Flowers Mission Home," *Great Clacton* (Essex), was attacked with diarrhœa and vomiting. At 7.30 on the morning of September 10th a medical man was called in and found T. P. suffering from purging, ("rice-water" stools), and vomiting, urine suppressed, cramps, collapse, with sunken features, pulseless, and blue. At 9.40 a.m. the case proved fatal. No post-mortem examination was made in this case. On September 11th, Dr. Cook, the Medical Officer of Health for the district, reported that the matron of the Home and nine other children had been attacked with purging and vomiting, and in the case of one of these (K. W., female, 10 years of age), where the stools were "rice-water" in character, a sample was sent to Dr. Klein for bacteriological examination (*see* Appendix B., page 179, Material XVI.). As a result of his examination Dr. Klein reported that the cultivations had proved negative as regards the presence of Koch's comma-bacillus. These cases all recovered; there was no further spread of the disease.

Leicester.

On September 9th, a case of suspected cholera at Humberstone Gate, *Leicester* (Leicestershire), was notified to Dr. Priestley, Medical Officer of Health for that Borough. The history of the case as reported by Dr. Priestley is as follows:—H. A., female, aged 74 years, was attacked with diarrhœa and vomiting at 4 a.m. on September 9th. On examina-

tion by the Medical Officer of Health the patient was found to be violently sick and purged, passing principally a watery, flaky fluid. She was pulseless and her hands and feet were shrunken and blue. There was suppression of urine; a husky, weak, whispering voice; whilst the temperature of the body was 94·6° Fahr. There were cramps in the arms and legs, and pain at the pit of the stomach, but no generally diffused abdominal pains. The brain was unaffected, the intellect being perfectly clear. H. C. died at 2 p.m. on September 10th, never having rallied from the state of collapse. A post-mortem examination was made the same evening, with the result that the organs of the body were all healthy and free from any signs of congestion, with the exception of the ileum and about one inch of the cæcum, next to the ilio-cæcal valve, in which positions there was distinct, well-marked congestion. A portion of the ileum was forwarded to Dr. Klein for bacteriological examination (*see* Appendix B., page 179, Material XII.). He reported the results of both the microscopical examination and of the cultivations to be positively indicative of true cholera. The patient had been subject to attacks of diarrhœa from time to time during recent years. For some weeks prior to her attack she had not been out of Leicester; but from the investigations of Dr. Priestley it appeared that she lived at an oyster shop, where a consignment of oysters from Cleethorpes had been received on September 8th. These oysters had been sent in their "native state," *i.e.*, covered with black, slimy mud. No distinct history could be obtained of the deceased having eaten any of these oysters, nor of her having come into contact with them in the way of washing them, &c.; but the statements made at the time were not regarded by the Medical Officer of Health as satisfactory.

Ilkeston. On September 9th a male, aged 20 years, residing at *Ilkeston* (Derbyshire), who was convalescing from an attack of enteric fever, was suddenly attacked with vomiting and diarrhœa, which persisted until September 17th, when he died. The day following the man's death, one of his sisters, aged 20 years, was attacked with symptoms strongly suspicious of cholera, and on September 19th, a second sister, aged 17 years, who had suffered from a slight attack of diarrhœa on September 15th, also developed symptoms of a choleraic nature. The sister first attacked died on September 19th, and a portion of her ileum was forwarded to Dr. Klein for bacteriological examination (*see* Appendix B., page 182, Material XXX.). Dr. Klein reported the results of his examination to be typical of cholera. On September 14th, a night-soil man, aged 56 years, employed at Ilkeston, was seized with symptoms typical of cholera and died the following day. An inquiry was made by Dr. Wheaton into the circumstances of the cases noted above, and his detailed report will be found in Appendix A., No. 12, page 145. The source of infection was not ascertained. No further cases were reported.

Handsworth. On September 9th an attack, suspected to be cholera, occurred at *Handsworth* (Yorkshire), which proved fatal on September 11th. The facts of the case supplied by Dr. Scott, the Medical Officer of Health, were as follows:—G. K., male, aged 57 years, butcher, residing at Hollinsend, Handsworth, was attacked on September 9th with sickness and diarrhœa. He was seen by Dr. Scott in the evening and was then found to be suffering from severe vomiting and purging, accompanied with cramps of the muscles of the abdomen, thighs, calves of the legs, toes, forearms, and fingers. There was constant thirst, as well as great depression and restlessness. The stools were very frequent and "rice water" in character; pulse feeble and rapid, temperature normal. The

purging and vomiting continued throughout the night, and on the morning of September 10th his condition was reported as follows:— Expression still more anxious and pinched than on previous evening; face livid; eyes sunken; extremities cold; temperature 95° Fahr.; pulse very feeble and rapid; the skin, especially of the extremities, cyanosed; vomiting and purging persistent; the vomited matters watery in character and containing whitish shreds; cramps well marked in the calves and toes, the muscles of the calves being drawn up into knots and the toes extended; consciousness maintained. By the evening the patient was stated to have passed into a state of profound collapse, and death took place at 4 a.m. on September 11th. A post-mortem examination was made at 11.30 a.m. the same day, with the following results:—Body still warm; rigor mortis well marked; skin of mottled appearance and livid in dependent parts. Heart: left side almost empty, right side nearly full of thick dark-looking blood, not coagulated. Lungs contracted, containing but little air, slight hypostatic congestion. Liver and kidneys pale. Spleen very much contracted. Stomach contained a considerable quantity of gruel-like fluid; mucous membrane showed patches of congestion and had a sodden appearance. Small intestines distended and containing a quantity of fluid similar to that found in the stomach, though more liquid, and having a larger number of whitish shreds; the mucous membrane showed patches of congestion, especially towards the cæcum. Large intestine distended, containing only small quantity of liquid. Bladder empty. A portion of the ileum was forwarded to Dr. Klein for bacteriological examination (*see* Appendix B., page 179, Material XIII.). Dr. Klein reported that cultivations yielded positive results as regards the presence of Koch's comma-bacilli. The movements of the deceased prior to his attack could not be definitely ascertained. It was, however, his custom to go to the neighbouring towns of Sheffield and Rotherham to buy meat for sale, and it is to be noted that a fatal case of cholera had occurred at Rotherham prior to his illness. No further cases were reported from this district.

Fulham.

On September 10th a female inmate (aged 51 years) of the *Fulham* Union Workhouse (London) was attacked with choleraic illness, which proved fatal the following day (September 11th). A portion of the ileum of this patient was forwarded to Dr. Klein for bacteriological examination (*see* Appendix B., page 179, Material XV.). Dr. Klein reported the results of his microscopic and bacteriological examinations to be indicative of true cholera. Dr. Copeman made inquiry into the circumstances of this case on behalf of the Board, and his detailed report will be found at Appendix A., No. 13, page 148. It was not found possible to trace any connexion between this case and any cholera infected person or place. Measures of disinfection were carried out, and no further cases were reported.

South Shields.

On September 10th a person living at *South Shields* (Durham), who had been suffering from slight diarrhœa for some days previously, was suddenly attacked with vomiting, purging, and cramps. The history of the case, as supplied by Dr. Turnbull, the Medical Officer of Health, is as follows:—A. W., male, aged 56 years, watchmaker, unmarried, living at South Shields, had for about three weeks prior to September 10th been drinking heavily. He went to bed at an unusually early hour on the evening of September 9th, complaining of indisposition, and was seized with diarrhœa and vomiting about 1 a.m. on September 10th. He was first seen by a medical man about 3 p.m. on that day,

and at that time he was suffering from severe purging and vomiting; the stools, of which he passed several during the time the doctor was in the room, were watery and copious, with white flocculent matter suspended in them (typical "rice water" in character); vomited matter watery and copious; cramps in abdomen and legs very severe, less severe in the arms and rest of the body; temperature, 96° Fahr.; pulse quite imperceptible at the wrist; acute abdominal pain, worse at intervals; voice, a husky whisper, and requiring great effort in its production; face pinched; eyes sunken, with dark areolæ; hands and feet cold; skin dry, wrinkled, and livid; urine suppressed; intense thirst; respiration slow and feeble; breath and tongue cold; patient in a state of collapse. During the next two days, September 11th and 12th, the patient rallied somewhat, the diarrhœa and vomiting gradually ceased, and the cramps and abdominal pain disappeared. The temperature rose to normal, the pulse became perceptible again and improved in character, and the patient was rapidly progressing towards convalescence, when on September 14th delirium tremens supervened and he died on September 15th from cardiac failure. No post-mortem examination was made. A sample of one of the stools passed on September 11th was forwarded to Dr. George Murray, Professor of Comparative Pathology, and Lecturer on Bacteriology, University of Durham College of Medicine, for bacteriological examination. Dr. Murray, after making a microscopical examination, together with peptone and plate cultures, reported that the case was indistinguishable from true cholera. For two or three weeks previous to his illness the patient had been drinking heavily in the lowest quarters of South Shields, but had not been outside the town. No definite information respecting his movements about the town could be obtained. Whilst drinking he was stated to have eaten voraciously any kind of food. Fragments of tomatoes were contained in the first stools and vomited matter. The sanitary circumstances of his lodgings were good. The following precautions were taken:—The patient was removed to the Infectious Diseases Hospital; the house where he had lived was disinfected; all food stuff destroyed, all bedding, carpets, and clothing burnt, walls stripped, ceilings whitewashed, and the whole place thoroughly cleansed. The yard and drains were sluiced with strong solution of perchloride of mercury, as also were the drains, &c. of all the premises which the patient was found to have visited. Burial took place five hours after death, the body was closely wrapped in sheets saturated with carbolic acid solution, and the coffin packed with a "disinfectant" powder.

On October 1st a second person in another part of the town was seized with choleraic illness, which proved fatal the next day. The following history has been supplied by Dr. Turnbull:—W. F., male, aged 46 years, plater in a ship yard, married, living at South Shields, was suddenly seized with vomiting and purging early in the morning of October 1st. The patient stated that he had been perfectly well prior to his attack. He had drunk several glasses of beer on the night of September 30th. He was first seen by his medical attendant at noon on October 1st. Dr. Turnball saw him at 3 p.m., when his condition was as follows:—Incessant diarrhœa and vomiting; stools watery, copious, with a greyish white deposit of flocculent and granular debris; the vomited matters copious and watery; cramps in the legs and abdomen, and to a less extent throughout the rest of the body; temperature 97° Fahr.; pulse imperceptible at the wrist; heart-sounds heard with difficulty, very slow (28) and soft; great abdominal pain, relieved by pressure; voice a husky whisper, produced with difficulty; expression

as of intense pain; face livid; eyes sunk; skin dry and cold; skin of feet and hands cold and dry; urine entirely suppressed; intense thirst; respiration slow, shallow, and laboured; condition of extreme collapse. The patient died at 1.30 p.m. on October 2nd. No post-mortem examination was made. A sample of one of the "rice-water" stools passed on October 1st was submitted to Dr. George Murray for bacteriological examination. Dr. Murray reported that from the results of his examination the case was in his opinion true cholera. This patient, prior to his illness, had not been outside South Shields for some months. He was not acquainted with the first case described above, and had never been in his company. No history could be obtained of his having taken improper food, or of his being exposed to insanitary conditions. The same precautions as those detailed above were taken. No further cases of suspicious illness were reported from South Shields in 1893.

East Retford.

On September 10th a man residing at *East Retford* (Nottinghamshire), was seized with choleraic illness which proved fatal in less than 16 hours. The history of the case as supplied by Mr. Walter Spencer, the Medical Officer of Health, is as follows:—W. G., male, aged 50 years, publican and bookmaker, residing at the Half Moon Inn, Market Square, Retford, attended Doncaster races on September 5th, 6th, 7th, and 8th during which period he was suffering from slight diarrhœa. On September 10th, although not feeling well, he attended to customers as usual on the premises of the Half Moon Inn up to 3 p.m. when he went to lie down for rest. At 4 p.m. he was seized with violent cramping pains in the arms and legs, accompanied by severe vomiting and diarrhœa. In consequence of these symptoms a medical man was called in, who observed in addition that the voice was a mere whisper, that the patient was very restless, and complained of great depression, that the evacuations were "rice water" in character, and that there was suppression of urine. The patient became rapidly worse and passed into collapse; extremities became cold and the surface of the body livid, and the face shrunken. Death occurred at 7.30 a.m. on September 11th, fifteen and a half hours after the onset of the illness. A post-mortem examination was made half an hour after death, when rigor mortis was very marked, temperature of surface 98·4° Fahr. Upon opening the abdomen the peritoneal surface of the bowels was observed to be congested, but no other abnormal condition was noticed. A portion of the ileum was forwarded to Dr. Klein for bacteriological examination (*see* Appendix B., page 179, Material XIV.). Dr. Klein reported the results of both the miscroscopical and bacteriological examinations to be indicative of true cholera.

Owing to the patient's occupation (bookmaker) it was not possible to exclude in this instance antecedent relation with cholera; but so far as the facts went no such relation was traceable, complete precautions as regards disinfection, were taken, and no further cases were reported from the district.

Mitcham.

On September 11th, a case of suspected cholera, which proved fatal on September 14th, occurred at *Mitcham*, in the Croydon Rural Sanitary District, (Surrey). The following is a summary of the history of the case, as reported by Dr. Darra Mair, the Medical Officer of Health:—H. B., male, aged 53 years, a resident at Mitcham, and employed at a local cornfactor's, was attacked at 10.30 p.m., on September 11th, with rather severe diarrhœa, which continued throughout the night and also during the next day (September 12th), although its severity was not sufficient to prevent his partially attending to his work. On returning home in

the evening he first complained of the diarrhœa to his friends, and feeling worse went immediately to bed (about 7 p.m.). Although he had taken some diarrhœa mixture, the diarrhœa now became very much intensified and was accompanied by severe cramps. A medical man was sent for at 10.30 p.m. The medical attendant reported that when he saw H. B. the cramps were very severe, affecting chiefly his arms and legs; that his expression was anxious, but that there was no cyanosis, pulse 120, feeble; temperature in the axilla, 97° Fahr.; tongue moist and coated with whitish fur. Also he reported that the patient complained much of thirst. No pain was experienced on pressing the abdomen. The general condition was one of moderate collapse. On September 13th the patient was seen by the Medical Officer of Health, at 1.45 p.m., his condition at that time was reported to be one of general collapse; he was very drowsy, much cyanosed about the legs, feet, and hands,—the skin of the latter being much puckered. His face was very pinched, expression indicated great pain, but there was no marked cyanosis, the lips only being a little dusky. The pulse was 120; the tongue was coated with thick brown fur, but was moist; temperature 97° Fahr.; very little, if any, urine had been passed since 10.30 the previous night; but the diarrhœa had abated considerably, and there had been no vomiting since 5 a.m. The cramps still continued. No motion had been saved; but some liquid was squeezed out of some sheets which had been placed beneath the patient, and this liquid, which had the appearance of dirty milk and water, was forwarded to Dr. Klein for bacteriological examination (*see* Appendix B., page 180, Material XIX.). Dr. Klein reported the detection of comma-shaped bacilli under microscopical examination—cultivations, however, proved negative as regards Koch's commas. H. B. was last seen by the medical attendant at 9 p.m., on September 13th, when his condition was reported as follows:—Temperature, 102·4° Fahr.; pulse 120, exceedingly feeble; respirations 28; tongue moister and cleaner; motion passed at 8 p.m., 1½ ounces of creamy consistency, much bile stained, chocolate colour, and contained many epithelial scales and blood corpuscles; very little urine voided; hands cold and rather blue; feet and legs warm and much less blue than in the afternoon; voice quite hoarse; cramps less frequent and less severe; no vomiting; still great thirst; face pinched, but not blue. Death took place at 2.30 a.m. on September 14th. At the post-mortem examination which was made on September 14th, the abdomen only was examined, the intestines were distended, pressed against the abdominal wall, and showed much injection of the capillaries. The right kidney was examined, the cortical portion was rather wasted; the medullary portion was apparently healthy; the capsule peeled easily, except one spot. The gall bladder contained about half an ounce of bile. The urinary bladder was quite empty. About one foot of the lower ileum was tied *in situ*, removed, and sealed up in a bottle, and forwarded to Dr. Klein for bacteriological examination (*see* Appendix B., page 180, Material XXI.), who reported the detection of comma-shaped bacilli by microscopical examination, but the absence of true cholera bacilli in the cultivations. As to the previous history of the patient, it appears that he had not been away from Mitcham for many weeks, except to Tooting for a walk on September 10th, with other members of his family. He and his family dined off roast pork on that day, all of them (five) partaking of it, and this pork was also eaten cold on the next day. None of the other members of the family were taken ill in any way. He admitted having drunk water from a pump in the yard in which he worked, though he had been told it was only fit for cattle. The only other clue that was found was that the patient had

been engaged, on September 9th, with several other men, in receiving a consignment of Russian oats that had just arrived from St. Petersburg. On inquiry, however, it was found that the oats had arrived in bulk, and were unloaded at the docks in London into sacks belonging to the employer of the patient, and that the patient merely carried the sacks on his back from the carts to the store at Mitcham. Moreover, his fellow workmen had been free from the disease, mild or otherwise. The usual precautions as to disinfection were taken, and no further cases were reported.

Lambeth.

On September 11th, T. E. (male), aged 61 years, residing at Kennington Road, *Lambeth* (London), was attacked with purging, vomiting, and cramps, the evacuations being described as "rice water" in character. From information furnished by the Medical Officer of Health of the London County Council, it appeared that T. E. had been to Ramsgate with his three daughters, from September 2nd to the 4th; he returned to London on September 4th. On the two following days (September 5th and 6th) he suffered from slight diarrhœa, which, however, did not continue after September 6th. From the latter date, although somewhat unwell, he remained free from diarrhœa until September 11th, when he was attacked early in the morning, as noted above. By 6 o'clock p.m. he had become so prostrated that some eight pints of saline fluid were injected into his veins. He revived for a short time, but died at 5.40 a.m. on September 12th. The results of the post-mortem examination made on September 12th were not such as would enable distinction to be made between English and Asiatic cholera. A portion of the ileum was forwarded to Dr. Klein for bacteriological examination (*see* Appendix B., page 180, Material, XVII.), who reported the results of the culture experiments to be positively indicative of true cholera. No connexion with any previous case of cholera was traced. The patient was stated to have been exceptionally careful in his diet, and was not known to have taken any article of food not shared by the rest of the family, all of whom, with the exception of one of the daughters, who was reported to have suffered from slight diarrhœa on September 6th, remained well. His movements were limited, as far as is known, to going between his home and his place of business in Little Canterbury Place, Lambeth. He is stated to have always drunk boiled water.

Manchester.

On September 11th, a man, aged 60 years, living in Horner Street, *Manchester* (Lancashire), was seized with purging, vomiting, and cramps, followed by collapse from which he subsequently recovered. The patient had returned home on September 10th from Grimsby, where he had been staying for five days. On September 14th the wife of the patient referred to above, a woman aged 53 years, was attacked with choleraic symptoms; she was first seen by a medical man on the morning of September 15th, when she was found to be suffering from vomiting, purging, and cramps; the stools are stated to have been flaky and colourless. In the evening of the same day she was in a condition of collapse, cyanosed and cold. She could not speak, but merely muttered indistinctly. Death took place at 8 p.m., less than 24 hours after the onset of the disease. A portion of the ileum of this patient, together with a sample of the dejecta, was forwarded to Dr. Sheridan Delépine, Professor of Pathology in the Victoria University, for bacteriological examination. Dr. Delépine reported that "the stools were quite fluid, "watery with greyish flakes suspended in the fluid, very fœtid, curved "bacilli were observed in the epithelial masses, but not grouped in any "typical fashion. After cultivation, spirilla of Asiatic cholera were "isolated and yielded positive results with the usual tests."

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On Cholera in [illegible]

On September 14th two women living in Kay Street, West Gorton, *Manchester*, were admitted to the Withington Union Hospital suffering from choleraic illness. The following history of the cases has been compiled from information obtained from local sources:—M. C., female, aged 44 years, married, was admitted to hospital on September 14th, suffering from purging, vomiting, and cramps. On admission the patient was in a state of collapse; face pinched, with dark rings round the eyes; skin cold; pulseless; temperature subnormal; great thirst; purging, stools very loose, dark coloured, passed involuntarily. The patient never rallied, and died on September 15th. About 24 hours after death the abdomen was opened, and a portion of the ileum removed; this was sent to Professor Delépine for bacteriological examination. Professor Delépine reported that the contents of the ileum consisted "of very thick mucus stained with biliverdine. "Walls slightly congested. No swelling of either Peyer's or solitary "glands. A large number of bacteria present among the flakes of "desquamating epithelium; among the bacteria a few comma-shaped "bacilli, not grouped in any typical fashion. After cultivation in "peptone solution and in gelatine, typical characters of cholera spirillum "obtained."

The second case was that of M. M., female, aged 73 years, mother-in-law to the patient referred to above, who was admitted to the hospital in consequence of the development of choleraic symptoms. In this case the purging and cramps were unaccompanied by vomiting. Stools in the first instance dark coloured, and afterwards pale and yellowish, with a very offensive odour; abdominal pain and cramps; voice weak; face pinched, with anxious expression; temperature subnormal; mind clear; urine not suppressed; considerable thirst; pulse very weak and slow. On the following day, September 15th, the condition of the patient was much improved, and she slowly recovered. A sample of the dejecta from this patient was sent to Professor Delépine for bacteriological examination, and he reported as follows:—"Fæces of M. M. received at "1 p.m. on 16th September; very fœtid, pale, yellow, semi-fluid; epi-"thelial flakes present. A large quantity of micro-organisms. After "cultivation, spirilla of Asiatic cholera found." Both patients had prior to the accession of choleraic symptoms been suffering for some days from diarrhœa. The two women occupied the same bed. Although no definite history of exposure to infection was to be obtained, it was ascertained that prior to their attack the patients had eaten freely of oysters which had come from Grimsby. The usual precautions as to disinfection were taken, and no further cases were reported to have occurred at Manchester in 1893.

Hurst.

On September 12th a case of reputed cholera occurred at *Hurst* (Lancashire) in the person of a man who had been to Cleethorpes on September 7th for the day. From local information it appears that the patient made no complaint of feeling unwell until 11 p.m. on September 12th, when the usual symptoms of choleraic diarrhœa set in, followed by collapse, death taking place at 5.30 p.m. on September 13th.

In view of the antecedents of this case it was not considered necessary for a post-mortem examination to be made. Precautions as to disinfection were taken, and no further cases were reported.

London Port.

On September 13th, a Thames lighterman, employed on the barge "Memory" was attacked, when at work on the barge below London Bridge, in the *London Port* Sanitary District, with symptoms suspicious of cholera. Upon the barge reaching Blackfriars Bridge he was

removed to St. Bartholomew's Hospital, where he ultimately recovered. The following history of the case is taken from the hospital records:— W. N., male, aged 20 years, lighterman residing at Park Street, Poplar, left home on September 6th, and was engaged on the barge "Memory" at Purfleet from that date until September 12th, dredging sand. This barge left Purfleet on September 12th, reached Millwall at 10 a.m., and London Bridge at 12.30 p.m. on September 13th. When passing London Bridge, W.N. was seized with griping pains in the abdomen; he got rapidly worse, and diarrhœa and vomiting commenced. The patient became so ill that he had to be taken off his barge at Blackfriars Bridge and removed to the hospital. The motions were described as having been very loose, light yellow in colour, with suspended white flakes. On admission into hospital, at 5.45 p.m., the patient was much collapsed, and evidently in much pain; face livid and shrunken; eyes sunken and half closed, pupils dilated; conjunctivæ slightly injected; voice weak and slightly hoarse; tongue brown, dry, and furred, not cold; sordes on lips; pulse 108, scarcely perceptible at wrist; temperature, 97·4° Fahr. in axilla; skin ashy grey, and moist; abdomen, very much retracted, recti prominent; pain and tenderness in epigastric region; fingers and toes cold, but not shrivelled; severe cramps in the soles of the feet; much thirst; no urine passed since 9 a.m. At 6.18 p.m slight cramps in calves; for two and a half minutes pupils alternately kept contracting and dilating equally on both sides, no cramps elsewhere during this period. At 6.25 cramps in the abdomen. At 8.30 temperature 97·2° Fahr.; pulse, 100; cramps in calves, feet, and abdomen, in the order named. At 8.40 patient much more collapsed, pulse scarcely perceptible; vomited clear, watery fluid. The patient continued to have severe cramps for about 24 hours; at first he had some troublesome vomiting, but after about five hours this ceased; he had no diarrhœa after admission to the hospital, his bowels acted for the first time the sixth day after admission; his urine was suppressed for 48 hours, and the first specimen, which was passed at 8.35 a.m. on September 15th, contained about one-sixth albumen. On September 14th, the patient showed considerable signs of improvement, his temperature remained subnormal, he had no relapse, and was discharged cured on September 23rd. No bacteriological examination was made in this case. No evidence could be obtained of this patient having been in contact with infection prior to his illness, or to his having eaten anything calculated to disagree with him. There was, however, strong suspicion that he had drunk Thames water, although specially cautioned by his father not to do so. The barge was disinfected under instructions from Dr. Collingridge, the Port Medical Officer of Health, and no further cases occurred on board.

Accrington.

On September 13th, a person residing at *Accrington* (Lancashire), was suddenly attacked by symptoms highly suspicious of cholera, which proved fatal the same day. The history of the case furnished by Mr. Thomas J. Monaghan, the Medical Officer of Health, is as follows:— A.M., female, aged 53 years, housewife, living in Stanley Street, Accrington, was attacked at 2.30 a.m., on September 13th, with persistent vomiting and diarrhœa, followed by cramps of the extremities and rapid collapse, death occurring at 9.30 p.m. No error or indiscretion of diet could be ascertained that would have accounted for the symptoms. The deceased had not been away from home for a considerable time prior to her illness. The death was certified to be due to "choleraic diarrhœa," but no post-mortem examination was made. The usual steps as to disinfection, are said to have been taken. On September

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14th, another suspicious case of a choleraic nature was reported to have occurred at Accrington, of which the following is the history as supplied by Mr Monaghan:—W.S., male, aged 75 years, commercial traveller, residing in Pearl Street, Accrington, who had been suffering from diarrhœa since the beginning of September, although not so severely as to prevent his following his usual occupation, became suddenly worse on September 14th, when he called in a medical man, who found him to be suffering from purging, griping, faintness, and cramps. He was perspiring freely, his skin was puckered, pulse 120, small and weak, temperature in mouth, 97° Fahr., face pinched, pupils contracted almost to pin's point, tongue and lips cold and shrivelled, surface of skin cold, voice tremulous, squeaking, and cracked. On September 15th the patient had a very copious liquid evacuation at 3 a.m., a sample of which was preserved for bacteriological examination. At 6 a.m. the symptoms increased in severity pulse became imperceptible at the wrist, temperature 96° Fahr. At 10 a.m. patient in state of collapse, and saline solution injected into veins; at 11.30 a.m. death took place. The sample of stool referred to above was forwarded to Dr. Klein for bacteriological examination (*see* Appendix B., page 181, Material XXVII.). Dr. Klein reported the result of his examination to be typical of true cholera. The source of infection could not be traced. The deceased had, in the course of his occupation, visited Manchester, Stockport, Whaleybridge, Rochdale, and other towns during the fortnight preceding September 14th. The usual precautions as to disinfection were taken, and no further suspicious cases were reported from Accrington during the year.

Croydon.

On September 13th, a person living at *Croydon* (Surrey), who had been suffering from slight diarrhœa for two or three days, was suddenly attacked with choleraic symptoms and died the following day. The history of the case, furnished by Dr. Wilde, the Acting Medical Officer of Health, is as follows:—J. K., male, aged 60 years, resident at Upper Grove, South Norwood, Croydon, was attacked on September 10th by slight diarrhœa, which persisted until September 13th, when there was sudden aggravation of the diarrhœa, which became choleraic in character and was accompanied by severe cramps, blueness of skin, suppression of urine, and collapse; death occurring on September 14th at 1 p.m. A post-mortem examination was made on September 15th, when the condition of the abdominal organs was found to be as follows:—Omentum excessively fat and adherent to the parietal peritoneum, stomach,—empty, mucous membrane covered with ropy mucus and presented patches of slate grey pigmentation here and there. Small intestine,—lower portion of ileum,—showed slight injection of some of the valvulæ conniventes, Peyer's patches and agminate glands sodden in appearance, neither prominent nor excavated. The sigmoid flexure of the rectum presented more acute congestion, there being large irregular patches of deep red injection. Intestinal contents feculent and grumous, liver adherent to diaphragm, substance pale and firm; kidneys and other organs healthy; bladder empty. A portion of the ileum and some of the bowel discharges were forwarded to Dr. Klein for bacteriological examination, as a result of which he reported the case to be distinctive of true cholera (*see* Appendix B., page 180, Material XXII.) The patient had resided in Croydon for twelve months prior to attack. No evidence could be obtained of his having been either in any infected district or in contact with any infected person, article, or food. There had further been no previous diarrhœa in the neighbourhood, except in the case of a child of the deceased, aged 4 years, who had suffered from a slight

attack of diarrhœa lasting three days, a fortnight before J. K. was attacked. No further cases were reported from this district.

Owston Ferry. [Gainsborough Rural Sanitary District.]

On September 13th, a woman, aged 58 years, living at *Owston Ferry*, in the Gainsborough Rural Sanitary District (Lincolnshire), was attacked with choleraic illness, which proved fatal on September 14th, about 20 hours after its onset. This patient is stated to have suffered from slight diarrhœa for some days prior to September 13th, but this diarrhœa had abated about 24 hours before the choleraic attack took place. Dr. Bruce Low made inquiry with respect to the circumstances of the case, and his report will be found in Appendix A., No. 10, page 137. No bacteriological or post-mortem examination was made. No definite connexion between the patient attacked and previous cholera could be traced, but there was apparently intimate and frequent intercommunication between Owston Ferry and Hull.

Newington.

On September 14th, a woman, residing in Tabard Street, *Newington* (London), was attacked with symptoms suspicious of cholera, and which proved fatal on September 18th. The history of the case, supplied by Dr. Millsom, the Medical Officer of Health, is as follows:—S. B., female, aged 53 years, was seized on September 14th at 2 a.m. with violent purging, accompanied by cramps in the stomach. She had suffered from slight diarrhœa for a week before the severe symptoms supervened. The diarrhœa, accompanied by vomiting, persisted throughout the day; the stools are stated to have been watery in character, the face pallid, eyes sunken, and extremities blue in colour, cold, and clammy. At 2 p.m. she was in a complete state of collapse; the pulse became almost imperceptible. At 8 p.m. some reaction took place, and the vomiting and purging diminished. On September 15th there was some improvement in the condition of the patient, and this improvement was maintained during the following day (September 16th). On September 17th there was a slight relapse, and on September 18th diarrhœa set in again in a violent manner, and the patient relapsed into a state of collapse, from which she never rallied, but died at midnight, September 18th–19th. At 1 p.m., on September 19th, a post-mortem examination was made by Dr. Millsom with the following results:—The small intestine was injected throughout its whole extent, but not to an exaggerated degree. Peyer's glands were not unduly distinct. The right ventricle and right auricle were full of fluid blood. The organs of the body were all fairly healthy, and the body in a well-nourished condition. A portion of the ileum was sent to Dr. Klein for bacteriological examination (*see* Appendix B., page 181, Material XXVIII.). Dr. Klein reported the results of his examination to be negativeas regards Koch's comma-bacilli. The deceased was stated not to have been out of the district for some time prior to her illness, except on September 8th, when she went with a friend to Greenwich and there bought some shrimps; she, however, is said only to have eaten a few, as the taste was disagreeable. She had eaten freely of pears with the peel on, and had also taken more tomatoes than usual before her attack. The usual precautions were taken, and no further cases were reported to have occurred in the district during 1893.

Derby.

On September 14th, a case suspected to be cholera occurred at *Derby* (Derbyshire), which proved fatal the same day. The history of the case as supplied by Dr. Iliffe, the Medical Officer of Health, is as follows:—C. N., female, aged 53 years, residing at "The Dun Cow," Bold Lane, Derby, had been quite well until 1.30 a.m., on September 14th, when she was attacked with diarrhœa, but this was said not to have become severe

until 9 a.m., about which time persistent vomiting supervened. About 4 p.m. a medical man was called in to see the patient; he found her in bed quite cyanosed; cold; with cramps of the calves of the legs; constant purging and vomiting; stools "rice water" in character. The patient rapidly became worse and died at 7 p.m. A post-mortem examination was made on September 15th, when the following appearances were observed:—Rigor mortis well marked; the body was that of a well-nourished woman, the face was bloated and of a dusky hue, a yellowish, muddy discharge, which was slightly tinged with blood, was oozing from the nostrils and mouth. The pupils were somewhat dilated, the finger-nails were very cyanosed, there was hypostatic discolouration of the posterior parts of the body. There was a congested appearance of the exterior of the small intestines, but none of the large intestines; the posterior wall of the stomach was congested in the same manner as the small intestines. A portion of the small intestine was split open, when a congested surface was exposed. Stomach and intestines were empty, except a small amount of yellowish, muddy liquid. The liver was undergoing fatty degeneration, and the spleen was small and shrivelled in appearance; the kidneys were not examined. A portion of the lower ileum was forwarded to Dr. Klein for bacteriological examination (*see* Appendix B., page 181, Material XXIV.). Dr. Klein reported the results of his examination to be positively indicative of true cholera. The deceased was stated to have, prior to her illness, led a very irregular life, her home being a resort of organ-grinders and other persons of that class for immoral purposes; she was further stated to have been a hard drinker, and to have been subject to epilepsy. Neither she nor her husband had been out of Derby for some time before her attack, and no information could be obtained of anyone going to the house who had been the subject of any illness whatever. There had been, so far as could be ascertained, no illness of a diarrhœal nature amongst any of the inhabitants in the neighbourhood where C. N. lived. The usual precautions as to disinfection, were taken, and no further cases were reported.

Stockton-on-Tees.

On September 14th, a case of suspected cholera occurred at *Stockton-on-Tees* (Durham), which proved fatal on September 15th. The history of the case as supplied by Mr. J. H. Clegg, the Medical Officer of Health, is as follows:—R. L., male, aged 46 years, a carter, living in Bowser Street, Stockton-on-Tees, had been at work until noon on September 14th, when he was brought home suffering from severe sickness and diarrhœa ("rice-water" stools) and cramps in the legs with abdominal pain. When seen by Mr. Clegg, at 8 p.m., the patient's face was pinched and anxious; pupils slightly dilated; skin of face dusky, and of hands and arms very dusky; limbs quite cold; abdomen warm; no pain; sickness and diarrhœa much less than earlier in the day; voice weak; intellect clear; no pulse at wrists; heart's action very feeble; respiration 60, shallow and sighing; temperature in rectum, 104·2° Fahr. At that time the patient was in a state of collapse and evidently dying; death took place at 3 a.m. on September 15th. A partial post-mortem examination was made on September 15th, the abdomen only being allowed to be opened. Rigor mortis well developed; face much shrunken; nearly all the small intestines of a rose-coloured hue externally, and the mesenteric veins filled with dark-coloured blood; liver dark and slightly enlarged; gall bladder full of bile; spleen almost black and very slightly enlarged; bladder contained a few drops of urine. The small intestine was opened in various places, but there was no sign of ulceration; contents of intestine in upper portion milky and of consistence of thin cream, in lower portion colour of pea-soup. A piece of the lower ileum was sent

to Dr. Klein for bacteriological examination (*see* Appendix B., page 181, Material XXV.). Dr. Klein reported the results of this examination to be negative as to the presence of Koch's comma bacillus. No evidence of exposure to infection could be obtained. The usual precautionary measures were taken and no further cases were reported.

St. Luke.

On September 14th a schoolboy residing in *St. Luke's* (London), was suddenly seized about 10 p.m. with symptoms choleraic in character, and was admitted to St. Bartholomew's Hospital soon after midnight. The history of the case, summarized from the hospital records, is as follows:—E. C. E., male, aged five years, schoolboy, living in Gee Street, St. Luke's, was quite well up to 10 p.m. on September 14th, at which time he was suddenly seized with severe vomiting and diarrhœa; in an hour and a half his bowels were opened six or seven times, accompanied with abdominal pain; motions loose and light coloured. On admission to the hospital, at 12.45 a.m. on September 15th, patient was pale and dusky; complexion earthy; eyes sunken and half closed; conjunctive injected; tongue clean and dry; sores on lips and teeth; breath warm; voice weak; pulse small, only just perceptible at wrist; respiration shallow and hurried; temperature 97° Fahr.; abdomen rigid, no tenderness; hands and feet dusky and cold; skin dry; extremely restless; no cramps; little abdominal pain; much thirst. For the first four or five hours patient was much collapsed; his restlessness was extreme; vomiting ceased about an hour after admission; bowels acted about six times in the first 24 hours; motions light in colour with white flakes, almost "rice water" in character, extremely offensive; urine suppressed for 24 hours. There were no cramps. After 12 noon on September 15th patient began steadily to improve. Temperature:—sub-normal after the first 24 hours, highest 99·6° Fahr. at 3 a.m. on September 15th. He was discharged cured on September 20th. A portion of a "rice-water" stool passed on September 15th was forwarded to Dr. Klein for bacteriological examination (*see* Appendix B., page 180, Material XXIII.). Dr. Klein reported that whilst from the microscopical examination there was some suspicion of the presence of comma-bacilli, cultivations proved negative as regards Koch's commas. No evidence could be obtained of the patient having been exposed to cholera infection, and with the exception of a piece of apple which the child had eaten at 6 p.m. on the day of attack, there was no history of improper food having been taken. No further cases were reported from this district.

Blackburn.

On September 17th, a person at *Blackburn* (Lancashire), who had been suffering from diarrhœa for some days, developed symptoms suspicious of cholera, and died on the following day—September 18th. The history of the case as supplied by Dr. Wheatley, the Medical Officer of Health, is as follows:—C., male, aged 40 years, living in Princes Street, Blackburn, had been to Wigan on September 12th and got wet through, he returned home somewhat exhausted; on the following day he was attacked with diarrhœa, which, however, was not severe enough to prevent his continuing his work. On September 14th he went to Lytham (20 miles), and returned home the same day worse. On September 15th the diarrhœa was much worse, and the patient stayed in bed. On September 16th, a medical man was consulted for the first time; he found the patient suffering from vomiting and diarrhœa; motions a mixture of fœculent material and mucous-like substance; the vomited matters had a greenish tint; pulse, fair; no collapse; temperature, 99° Fahr.; no pain; great thirst. In the evening diarrhœa somewhat less. On September 17th, in the morning, the diarrhœa was less, and

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the general condition of the patient improved. At 4.30 p.m., patient was seized with violent vomiting and diarrhœa, which persisted incessantly until 8 p.m., both vomited matter and stools "rice water" in character. On September 18th, at 2·30 a.m., diarrhœa less, but patient much collapsed. At 5·30 a.m., collapse increasing; face drawn; skin cold and clammy; temperature, 96° Fahr. in mouth; pulse, 128, hardly perceptible; voice, whispering; aching of limbs and back; no abdominal tenderness; mind clear. The diarrhœa stopped about 6 a.m. At 1.30 p.m. breathing more rapid; urine suppressed (catheter passed, no urine in bladder, and none passed for about 24 hours); patient died at 2.50 p.m. A sample of the bowel discharges from the patient was forwarded to Dr. Klein for bacteriological examination (*See* Appendix B., page 182, Material XXIX.). Dr. Klein reported that the material had apparently been disinfected before being forwarded, and that the cultivations were sterile. The deceased had been travelling about before his illness, but no history could be obtained of his having been to any town where cholera existed, or of his having been in contact with any infected person. The usual precautions were taken, and no further cases were reported from the district.

River Tyne Port.

On September 17th the steward of the barque "Jeannie," lying in the *River Tyne* Port Sanitary District, was attacked with symptoms, suspicious of cholera, and died the next day. The following notes of the case were supplied by Dr. Armstrong, the Medical Officer of Health:—H. C. H., male, aged 59 years, steward on board the "Jeannie," complained of feeling ill about 11.30 a.m. on September 17th, and went to bed. About 3 p.m. he was seized with severe diarrhœa (watery stools) and vomiting. There were no cramps. The patient died on September 18th. He was not seen by a medical man before death. A portion of the intestine was forwarded to Dr. George Murray for bacteriological examination, and he reported that the contents of the intestine "contained comma-bacilli." The barque "Jeannie," which had left Quebec on June 27th, arrived at the Tyne Port on August 4th, and had been lying there to the date of the deceased's illness. No history of any communication with persons, things, or places previously infected with cholera could be obtained. The vessel was disinfected, and no further cases occurred on board.

Hackney.

On September 18th a person residing at *Hackney* (London) was attacked with illness suspected to be cholera, and was admitted the same day into St. Bartholomew's Hospital, where he ultimately recovered. This patient was seen by Dr. Copeman, on behalf of the Board, and the following history has been partly drawn up from his memorandum and partly from the hospital records:—T. S., male, aged 26 years, residing at Ottaway Street, Hackney, was quite well until 1 a.m. on September 18th, when he woke up with pains in the abdomen, vomiting, and diarrhœa; cramps in the legs began after about ten minutes; the purging was stated to have been almost incessant until 2 p.m., when it stopped; stools "rice water" in character. At 3.15 p.m. the patient was admitted into hospital. On admission he was in state of collapse; skin cold; pinched appearance; eyes sunken; very restless; frequent retching, with little watery vomit; temperature, 99·2° Fahr. At 7 p.m. little less pain; vomiting ceased; temperature, 98·2° Fahr. The patient had a very restless night, with cramps in the legs. On September 19th general condition improved; temperature, morning, 96° Fahr.; evening, 98·4° Fahr. The patient passed no urine for 24 hours after admission. He continued to improve, and made a rapid recovery, and was discharged cured on September 26th. His temperature re-

mained subnormal. A sample of one of the "rice-water" stools, passed on September 18th, was forwarded to Dr. Klein for bacteriological examination (*See* Appendix B., page 182, Material XXXV.). Dr. Klein reported the result of his examination to be negative as regards comma-bacilli. For the two days prior to this patient's attack his meals had been as follows:—September 16th, breakfast, bloater; dinner, whelks; tea, eggs and bacon. September 17th, breakfast, eggs and bacon; dinner, hot roast pickled pork; tea, winkles; supper, cold pork and greens. His wife and child partook of the same food and remained well. The usual precautions as to disinfection were taken, and no further cases were reported from the district.

Liverpool.

On September 18th, a police constable at *Liverpool* (Lancashire), was attacked by symptoms suspicious of cholera, which proved fatal on September 19th. The history of the case, as obtained from local sources, is as follows:—W. T. C., male, aged 29 years, police constable, residing in Elwy Street, Liverpool, had been on duty during the night of September 17th and returned home shortly after 6 a.m. on September 18th. He went to bed, where he remained until noon, when he got up apparently well and had, with other persons in the house, dinner consisting of cold roast pork, sage, and onions. About 5 p.m. he went out for a walk, and on return said he had had a slight attack of diarrhœa. He went to bed about 6.30, but in less than half-an-hour he was attacked with vomiting and purging. He then went to see a medical man and fainted whilst in his surgery and again on his return home. At 10 p.m., as the patient appeared to be worse, another medical man was sent for, and on his arrival he found W. T. C. cold, exhausted, and almost pulseless; at that time the patient, who had been purged six times since 8 p.m., complained of cramps in his legs and abdomen. He became insensible about 1 a.m. on September 19th and died at 6 a.m. In view of the suspicious nature of the symptoms, an inquest was held and the evidence adduced not being satisfactory to the jury the inquest was adjourned for a post-mortem examination to be made by Dr. Barr. At the adjourned inquest Dr. Barr gave the results of his examination as follows:—Post-mortem rigidity was present and well marked; the body was a dusky grey colour, but there was only slight post-mortem lividity; the skin and subcutaneous tissue contained little or no fluid, putrefaction of the skin over the abdomen had commenced; the heart was soft and flabby, and all cavities contained thick, dark fluid blood of the consistence of tar; both lungs were congested, especially on their posterior aspects, with thick, dark tarry blood; there was œdema of the lungs, the congestion was very recent and must have occurred just before death; the liver was quite blanched and contained scarcely any blood; the kidneys also were bloodless; the spleen was very dark, almost black, and friable. The intestines were very translucent and contained a considerable quantity of very liquid "rice-water" like material; the blood-vessels of the small and large intestines were enlarged; the intestinal walls were very thin and the mucous membrane was almost completely stripped of its epithelium; the structure of the brain was healthy. A piece of the lower intestines and a portion of one of the stools were forwarded to Dr. Klein for bacteriological examination (*see* Appendix B., page 182, Material XXXI.). Dr. Klein reported that whilst the results of the microscopical examination demonstrated the presence of comma-bacilli, the cultivations all remained sterile, owing to the fact that glycerine had been added to the specimens before they were forwarded to him. A second piece of the intestine accordingly was forwarded to Dr. Klein for examination (*see* Appendix B., page 184, Material XLI.). Dr. Klein reported the result of his examination of this specimen to be typical of true cholera.

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The Medical Officer of Health reported that there was no evidence of the means by which the disease had been contracted, and that no other person in the house suffered from the disease. No further cases of reputed cholera occurred in Liverpool until the afternoon of October 6th, when a man residing in Northumberland Street was attacked by vomiting and purging, followed by cramps in the arms and legs. When seen on October 7th by a medical man the patient was in a state of collapse, and died at 4 p.m. on that day. A post-mortem examination was made by Dr. Roberts, who reported as follows:—"The intestines, which, on the peritoneal aspect were pinkish "and somewhat sticky to the feel, contained 12 ounces of a slightly "sanious fluid of the consistence of thin oatmeal gruel. This fluid "was loaded with epithelium and débris. The mucous surface of the "small intestines was denuded in a great measure of its epithelium, and "there were numerous sub-mucous extravasations, especially towards "the cæcal end. The stomach contained about 10 ounces of a thin "white fluid, and the mucous coat was pale with numerous points of "extravasations showing underneath. The right side of the heart was "full of thick, tarry-looking blood. The lungs were somewhat "shrivelled, and on putting the hand into the pleural cavity, the sticky, "soapy feel was very marked (this was observable, but not to the same "degree in the peritoneal cavity). There were numerous sub-pleural "extravasations on the lungs. The liver was pale, and the gall "bladder very distended. The spleen was small—weighing less than "five ounces." A portion of the intestinal contents was forwarded to Dr. Barron, Professor of Pathology in the University College, Liverpool, for bacteriological examination. Dr. Barron reported that the material had given cultivations which were indistinguishable from those of Koch's cholera bacilli. No connexion with any previous case of disease of a choleraic nature could be traced—the patient had eaten some mussels on the day when he was attacked. No further cases were reported from Liverpool during 1893.

North Bierley.

On September 18th the first of a series of seven attacks of choleraic illness, of which six proved fatal, occurred at *North Bierley* (Yorkshire). All the cases commenced in the fortnight ended October 1st. Five of the patients were members of the same family; of the remaining two patients, one had nursed and the other had helped to lay out one of the earlier cases. A piece of the ileum of the patient first attacked, whose death occurred on October 3rd, and a sample of the dejecta of a person who was attacked late in the series were forwarded to Dr. Klein for bacteriological examination (*see* Appendix B., page 185, Materials XLV. and XLV*a*.). Dr. Klein reported that, as regards the first case, the cultivations gave negative results, whilst in the second case the results obtained were typical of cholera. The outbreak was made the subject of a special inquiry by Dr. Bulstrode, whose detailed report will be found in Appendix A., No. 14., page 151. The origin of the infection was not satisfactorily traced. No further cases were reported from the district.

Lewisham.

On September 20th a person residing in *Lewisham* (London) was attacked with diarrhœa, and as he subsequently developed symptoms suspicious of cholera, was removed to St. Bartholomew's Hospital on the following day. The history of the case, as obtained from the hospital records, is as follows:—A. B., male, aged 15 years, printer, residing in Thesiger Road, Penge, Lewisham, was attacked with diarrhœa and abdominal pains, on September 20th; in the evening after the commencement of the symptoms the patient ate a bloater. On Sep-

tember 21st, after having had a good night, the abdominal pain returned about 6 a.m.; at 8 a.m. he suffered from vomiting; at 10 a.m. he was admitted into St. Bartholomew's Hospital, and was at that time much collapsed; vomited frequently a bile-stained viscid fluid; slight cramps in the legs; some purging, stools light coloured, but not "rice water" in character; temperature, 98° Fahr. On September 22nd, general condition much improved; temperature—morning 96·8° Fahr., evening 97·4° Fahr. His progress towards recovery was rapid, and he was discharged cured on September 26th. A sample of one of the stools passed on September 21st was forwarded to Dr. Klein for bacteriological examination (*see* Appendix B., page 182, Material XXXII.). Dr. Klein reported the result of his examination to be negative as regards comma-bacilli. No history could be obtained in this case of the patient having been exposed to infection, or of his having eaten anything likely to disagree with him prior to his attack. The usual measures as regards disinfection were taken, and no further cases were reported.

Newcastle-upon-Tyne.

On September 21st, Dr. Armstrong, the Medical Officer of Health for Newcastle-upon-Tyne, reported the occurrence of two cases of severe diarrhœa accompanied by vomiting, cramps, and collapse, in a house in Conyers Road, *Newcastle-upon-Tyne* (Northumberland), one patient being attacked on September 20th and the other on September 21st. Both cases proved fatal, the one on September 21st and the other on September 22nd. Bacteriological examination of the discharges was made by Dr. George Murray, Professor of Comparative Pathology and Lecturer on Bacteriology, University of Durham College of Medicine, who reported that in his opinion both patients had suffered from "Asiatic cholera," Koch's comma-bacilli being found in the matters vomited by the first person attacked and in the bowel discharges of the second. On October 2nd Dr. Armstrong reported the occurrence of a case of suspected cholera at a fish shop in Nelson Street, Newcastle-upon-Tyne. The patient in this instance was attacked on October 1st, and as she was too ill to be removed to hospital was treated at home. She was stated to have suffered from diarrhœa, vomiting, cramps, and collapse, with a temperature of 95·2° Fahr. and an imperceptible pulse. This patient ultimately recovered. Some of the bowel discharges were examined by Dr. George Murray, who reported that he found the comma-bacilli of Asiatic cholera. As the patient was reported to have eaten some "Dutch native oysters," on September 28th, some oysters of the same batch were submitted to bacteriological examination, with, however, negative results. On October 9th a case suspicious of cholera occurred in the person of a woman residing in Drury Lane, Newcastle-upon-Tyne, who for a month prior to attack was reported to have been drinking heavily of beer. In this case there was reported to be acute diarrhœa, with vomiting and cramps; there was, however, no huskiness of voice or lividity of surface, and the evacuations are stated not to have presented any appearances characteristic of cholera. Specimens of the discharges were submitted to Dr. George Murray, who, after having made a bacteriological examination, pronounced them to contain the "bacilli of Asiatic cholera." The patient ultimately recovered. In all the above cases, except that which commenced on October 2nd, the patients were removed to hospital, and all necessary measures as to disinfection taken by the Medical Officer of Health. No connexion with any previous case was traced.

On September 22nd W. B., male, aged 49 years, residing at Cavendish Road, *Idle* (Yorkshire), who had been suffering for some

Idle.

days from diarrhœa, was suddenly attacked with violent vomiting and purging, accompanied by cramps of various muscles. The patient is stated to have been greatly collapsed, with cold extremities, and only able to speak in a whisper. His countenance was stated to be anxious and sunken, and his pulse imperceptible at the wrist. The symptoms persisted for some 36 hours, and then the patient gradually improved. Dr. Honeyburn, the Medical Officer of Health, examined some of the dejecta on the morning of September 22nd, and reported that he found numerous comma-shaped bacilli on microscopical examination, and upon making cultivations he obtained almost pure culture of comma-shaped bacilli, that he could not distinguish from the comma-bacilli of Asiatic cholera. A sample of the dejecta was forwarded to Dr. Sims Woodhead on September 23rd for bacteriological examination. Dr. Sims Woodhead reported that the result of his examination, both microscopical and bacteriological, gave positive evidence of cholera. No history could be obtained of the patient having been in communication with any person or place infected prior to his attack, or of his having eaten any suspicious food. The patient eventually recovered, and no further cases were reported from the district.

Islington.

On September 23rd a person residing at *Islington* (London) suffered from symptoms of a choleraic nature. The following history was supplied by the Medical Officer of Health of the London County Council :—A. K., male, aged 53 years, living at a lodging-house in Campbell Road, Islington, was attacked on September 23rd at 8 p.m. with abdominal pain, vomiting, diarrhœa, and cramps in the limbs. At 11 p.m. he was admitted to the St. Mary's Infirmary, Islington; on admission he was stated to have been much collapsed, and to have been suffering from severe vomiting and diarrhœa; the stools were described by the nurse to have been like "rice water." An hour or two after admission to the infirmary he began to improve, and quickly rallied; on the following day he was quite convalescent. There was stated to have been no other cases of similar illness in the lodging-house whence he was removed. The patient was a vagrant, and had been to several places in the neighbourhood of London prior to his illness. On September 19th he went to Wood Green, returning to Islington at night; a day or two later he went to St. Mary Cray and slept at a lodging-house there, the address of which he could not give. He had while at St. Mary Cray eaten some damsons and boiled pork, but had not had any shell-fish. On September 23rd, the day when his illness began, he returned from St. Mary Cray. No bacteriological examination was made in this case, as the stools had not been preserved.

St. George-the-Martyr, Southwark.

On September 23rd a man resident at Quinn's Square, Waterloo Bridge Road, in the district of *St. George-the-Martyr, Southwark* (London), was attacked with diarrhœa, which subsequently assumed a choleraic character, and which proved fatal on September 26th. From information furnished by the Medical Officer of Health of the London County Council, the following history has been drawn up:—R. W., male, aged 60 years, glass-cutter, was attacked with diarrhœa on September 23rd; on September 24th the diarrhœa diminished in the earlier portion of the day, but returned in the evening; on September 25th he went to work, but was compelled to return home at noon on account of severe diarrhœa accompanied with vomiting. On September 26th the vomiting and purging continued, and the motions are stated to have been blood-stained; the patient collapsed in the evening and died at 10 p.m. There was abdominal pain throughout the illness, but the patient never complained of any cramps in his limbs. A post-mortem

examination was made on September 27th, at 3 p.m., with the following results:—Body of a fairly well-nourished man; rigor mortis well marked; heart normal; some old adhesions at apex of right lung, engorgement and œdema of lungs, but no hepatisation; spleen not enlarged; liver pale and friable; kidneys, normal; intestines injected throughout their whole length; a small collection of fluid in the peritoneal cavity; the intestines contained some pink fluid; there were sub-mucous hæmorrhages in the lower ileum and large intestine, these hæmorrhages were specially well marked in the head of the cæcum and on the colon. A portion of the lower ileum was forwarded to Dr. Klein for bacteriological examination (*see* Appendix B., page 183, Material XXXIX.), Dr. Klein reported the results of his examination in this case to be positively indicative of cholera. There was no history to be obtained of any exposure to infection. The deceased, with his family, had taken up his residence in Quinn's Square about four weeks before his attack. No strangers were subsequently entered as tenants in the block, with the exception of a family which came in after the commencement of R. W.'s illness. Nothing definite could be discovered with regard to the man's movements during the days immediately preceding his illness; it was, however, ascertained that he had not slept away from home. No further cases were reported from this district during 1893.

Rowley Regis.

On September 23rd two persons residing in Lower Chapel Street at Tividale, in the *Rowley Regis* Urban Sanitary District (Staffordshire) were attacked by choleraic illness, from which one (a female aged 60 years) died on September 24th, 23 hours after the onset of the disease; the other (a female, aged 60 years) recovered. On September 24th two more persons living near those already referred to, were attacked with similar symptoms, and of these one (a female aged 47 years) died on September 25th, after an illness of 21 hours. A portion of the ileum of this patient was sent to Dr. Klein for bacteriological examination (*see* Appendix B., page 183, Material XXXVIII.). Dr. Klein reported the results of his microscopic and bacteriological examination to be typical of true cholera. Subsequently four further cases of choleraic disease were reported from the same locality, two (a female aged 30 years, and a male aged 67 years) on September 25th, and two (a female aged 31 years and a male aged 5 years), all of whom ultimately recovered. Dr. Sweeting made inquiry into the circumstances of the outbreak on behalf of the Board, and his detailed report will be found in Appendix A., No. 15, page 155. No definite connexion with any previously infected person or place was made out.

West Malling. [Malling Rural District.]

On September 24th, a case with symptoms suspicious of cholera occurred at *West Malling*, in the Malling Rural Sanitary District (Kent), which proved fatal on September 26th. From the report of Dr. Butterfield, the Medical Officer of Health, it appears that E. F., female, aged 43 years, had walked to Maidstone, a distance of five miles, on September 23rd, wheeling a perambulator. She returned at 7 p.m., apparently quite well, and ate some sausage-turnover, of which her husband also partook for supper. At 7 a.m. on September 24th she became faint and was violently purged. During the course of the day the purging was accompanied by vomiting and cramps of the extremities; these symptoms continued during the next day, and the patient died at 7.40 p.m. The intestinal discharges are stated to have assumed a "rice water" character on September 25th. A portion of the bed-linen which had been saturated with intestinal discharges was sent to Dr. Klein for bacteriological examination (*see* Appendix B., page 184,

Material XLII.). Dr. Klein reported the results of his examination to be doubtful as regards cholera, results possibly due to the "disinfection" of the sheet before being forwarded. No history could be obtained of any exposure to previous infection; neither the woman's husband nor any persons living in the neighbourhood suffered, so far as can be ascertained, from diarrhœa. The usual precautions were taken and no further cases were reported.

Coton Hill Asylum.

On September 26th an inmate (aged 52 years) of the Coton Hill Private Asylum (Staffordshire), was attacked with symptoms suspicious of cholera and died the same day. A second inmate (aged 56 years) was attacked on September 29th with similar illness, which proved fatal in eight hours. A portion of the ileum of the second patient was forwarded to Dr. Klein for bacteriological examination (*see* Appendix B., page 184, Material XLIII.). Dr. Klein reported the result of his examination to be positive as regards the presence of Koch's comma-bacilli. A special inquiry into the circumstances of this outbreak was made on behalf of the Board by Dr. H. T. Bulstrode (*see* Appendix A., No. 16, page 159). No connexion with any previous case of cholera was established. Stringent measures of disinfection were adopted and no further cases were reported.

Battersea.

On September 30th a suspicious case of choleraic illness occurred at *Battersea* (London), which proved fatal on October 2nd. The history as furnished by the Medical Officer of Health of the London County Council is as follows:—E. R., female, aged 70 years, living in Ponton Road, Battersea, was attacked with diarrhœa on September 30th, which continued throughout the day; the character of the evacuations was not ascertained, and the diarrhœa is stated to have ceased in the same evening and not to have returned. There was no record of any pain. On October 2nd the patient suffered from vomiting, the general conditions became weaker, and she died in the evening. There was no other illness in the house. The patient is stated to have eaten no fish of any kind; her diet had always been very simple. She had not been from home for upwards of a year prior to her illness. She had been subject to fainting fits from time to time. There was no post-mortem or bacteriological examination made in this case.

Crondall. Hartley Wintney Rural District.

On October 2nd, at *Crondall*, in the Hartley Wintney Rural Sanitary District (Hampshire), occurred the first of a series of diarrhœal attacks, choleraic in character, affecting certain members of two households. The following summary of the outbreak has been supplied by Mr. Denny, the Medical Officer of Health:—Rose B., female, aged 14 years, living at Heath Lane, Crondall, was attacked on October 2nd with vomiting, purging, and abdominal pains; temperature, 101° Fahr; tongue, dry. The diarrhœa and vomiting persisted from 24–36 hours and were succeeded by a certain amount of collapse; temperature, subnormal. The patient was quite convalescent on October 9th.

Ruth B., female, aged 37 years, mother of Rose B., was attacked suddenly on October 3rd with symptoms similar to those referred to above, but much more severe in character, accompanied by cramps in the calves of the legs, in the abdomen, and in the arms. This patient became much collapsed, but ultimately became convalescent and was quite well on October 16th. A sample of the bowel discharges from this patient was forwarded to Dr. Klein for bacteriological examination (*see* Appendix B., page 185, Material XLIX.). Dr. Klein reported that upon microscopical examination it apparently contained some comma-shaped bacilli, but cultivations proved negative as regards the presence of Koch's comma-bacilli.

Albert B., male, aged 6 years, son of Ruth B. and brother of Rose B., was attacked on October 3rd with similar symptoms to those referred to in the case of Rose B., but in this case the symptoms were much milder in character and the patient was quite well on October 10th.

Edith T., female, aged 15 years, niece of Ruth B., and residing in the same neighbourhood, was similarly attacked on October 5th, but in this case the cramps were slight. This patient was well on October 16th.

Edwin T., male, aged 45 years, fish seller, father of Edith T., was attacked on October 22nd with purging, vomiting, pains in the abdomen, very severe cramps in the calves of his legs, followed by slight collapse; recovered October 26th.

Jane S., female, a nurse, was similarly attacked with diarrhœa, vomiting, and pain in abdomen on October 23rd, this patient, however, soon rallied and was quite well on October 26th.

All the patients lived in two out of a small row of four houses. The husband of Ruth B. was a journeyman bootmaker and worked at Aldershot. Edwin T., in following his trade as a fish seller, visited numerous places, most frequently, Aldershot. Jane S. came from Odiham the day before she was attacked with illness; none of the other persons attacked had been from home for some time before their illness. The water supply was obtained from a deep well, the water of which was stated to be contaminated at the time with "vegetable and other matter." No history of exposure to infection could be obtained. Disinfection was duly carried out and no further cases were reported.

Gloucester.

On October 2nd, a man at *Gloucester* (Gloucestershire) was attacked with choleraic illness which proved fatal the following day. The history of the case as supplied by Dr. J. Campbell, the Medical Officer of Health, is as follows:—C. W., male, aged 64, gardener, living in Alma Place, Gloucester, was apparently in good health until the afternoon of October 2nd, when he was seized, whilst at work in his garden, with violent purging and vomiting, followed by cramps in the extremities and the abdomen. These symptoms persisted throughout the night, and the next day the patient became collapsed, and death took place at 8 p.m. (October 3rd). A piece of the ileum of this patient was forwarded to Dr. Klein for bacteriological examination (*see* Appendix B., page 184, Material XLIV.). Dr. Klein reported the result of his examination to be negative as regards the presence of comma-bacilli. There was no history of the deceased having eaten any food likely to have given rise to the symptoms observed. Prior to his attack he had been in fairly good health, and had not suffered from diarrhœa. The usual steps as to disinfection were taken, and no further cases were reported.

Ormskirk.

On October 7th, Mr. J. J. Hanly, L.R.C.P.E., of Ormskirk, Lancashire, forwarded to Dr. Klein for examination some bowel discharges from a patient who had been attacked by choleraic disease at Green Lane, *Ormskirk*, on October 6th. The history of the case, as furnished by Mr. Anderton, the Medical Officer of Health, and by Mr. Hanly, the medical attendant, is as follows:—P. K., male, aged 33 years, attacked by vomiting and purging about midnight on October 5th–6th, and at 2 a.m. Mr. Hanly was summoned and found patient suffering from persistent diarrhœa and vomiting; temperature 97° Fahr.; pulse 150, thready; surface of body cold and cyanosed; cramps attacking limbs at short intervals; urine suppressed. Death occurred at 4.30 a.m. on October 9th. The deceased was said to have been in his usual health prior to his attack, and to have partaken, on October 5th, of a hearty dinner of pea-soup and bacon, and to have had tea with bread and butter in the evening. A

post-mortem examination was made and a portion of the ileum forwarded to Dr. Klein. An account of the results of Dr. Klein's examination of the bowel discharges and of the lower ileum will be found in Appendix B., page 185, Materials XLVIII. and L. respectively. In neither instance were positive results as regards cholera obtained.

Balby [Doncaster Rural District.]

On October 7th a child residing at *Balby*, in the Doncaster Rural Sanitary District (Yorkshire), was attacked with choleraic symptoms and died the same day. The facts of the case as supplied by Dr. Mitchell Wilson, the Medical Officer of Health, were as follows:—M. E. L., female, aged six years, residing at Carr Hill, Balby, was attacked about 4 a.m. on October 7th with vomiting and purging. A doctor saw the child for the first time about noon the same day. He found her in a state of collapse and passing watery stools as she lay in bed; she died at 6 p.m. Three days later, on October 10th, H. L., male, aged 10 years, a brother of M. E. L. was attacked in the early morning with severe pains in the body, vomiting and purging; stools "rice water" in character; this child ultimately recovered. A sample of one of the "rice-water" stools of the latter patient was forwarded to Dr. Klein for bacteriological examination (*see* Appendix B., page 185, Materials LI.). Dr. Klein reported the result of his examination to be typical of true cholera; the material upon cultivation affording an almost pure culture of Koch's comma-bacillus. Both children had attended school regularly until the afternoon of October 6th (Friday), and before that date they had neither of them been away from Balby. The water used by the family for drinking purposes was obtained from a well in the back yard near the house. On chemical analysis the water was found to be very much polluted, and upon opening the well, leakage was seen to be entering it from partly blocked drains situate close to the well. No connexion with any previous case of choleraic illness could be traced. The necessary disinfection was carried out and no further cases were reported.

Rawmarsh.

On October 9th, a person resident at *Rawmarsh*, was attacked with symptoms highly suspicious of cholera, which had a fatal result on October 10th. The history of the case, as supplied by Dr. Picken, the Medical Officer of Health, is as follows:—M. A. M., female, aged 42 years, residing in Pens Lane, Rawmarsh, suffered from slight diarrhœa on October 9th, but went about her duties as usual, and at 5 p.m. was sitting on her doorstep knitting. Between 5 and 6 p.m. she was found lying upon the ground in a state of collapse; thereafter there was persistent vomiting, but not much evacuation from the bowels. The bowel discharges were stated to have been clear, like water. When seen at 11.30 p.m. the patient was in a state of collapse; features pinched; lips blue; pulse imperceptible; voiceless; temperature under 95° Fahr.; and complaining of pain and cramps in the arms and legs and pain in the back. She died at 5 a.m. on October 10th. The stomach and parts of the intestines were removed shortly after death and forwarded to Dr. Klein for bacteriological examination (*see* Appendix B., page 186, Material LII.). The results of Dr. Klein's examination were confirmatory of cholera. The Medical Officer of Health could not ascertain that the diseased had eaten any shell-fish, fish, or anything unusual prior to her attack. There had been no visiter at her home; she had, however, been to Rotherham for a short time on the evening of October 7th, but no connexion with any previous case of cholera could be traced. The usual measures of disinfection were carried out, and no further cases were reported from the district.

On October 13th a case of reputed cholera occurred at *Keighley* (Yorkshire), which proved fatal the same day. The history of the case as supplied by Dr. Scatterty, the Medical Officer of Health, is as follows:—L. D., female, aged 59 years, living in South Street, Keighley, was on October 12th apparently in her usual health, except for the fatigue resulting from nursing a sick daughter who had been suffering for some five weeks from some uterine complaint. During the afternoon of October 12th, L. D. ate an apple and partook of apple pie for supper. About 3 a.m. on October 13th she awoke with vomiting, diarrhœa, and gastric pain; the diarrhœa got worse and, cramps having set in, a medical man was called in about 9.30 a.m. From 9.30 a.m. until 5 p.m. the symptoms persisted, and at 5.15 p.m. death took place. No post-mortem or bacteriological examination was made in this case. Except the apple mentioned above it is stated that nothing of an irritating nature had been eaten, nor could any information as to connexion of the patient with any infected person or place be obtained. In fact the deceased is said to have hardly ever left the house for five weeks prior to her attack. Three subsequent cases of suspicious illness in the persons of three sisters were connected with the case; one sister lived at Ingrow in the Bingley Township District (*see* page 46, *post*), and the other two at Hey Gardens, Keighley. The first of the sisters living at Keighley to be attacked was an unmarried woman between 60–70 years of age, who had with her other two sisters visited at the house of L. D. referred to above, during L. D.'s illness; and had assisted in the housework. She was attacked on October 14th, the day following L. D.'s death, with vomiting, diarrhœa, and cramps. Her attack was not very severe, and she ultimately recovered. The second sister, Mrs. B., a widow, aged 70 years, was attacked with diarrhœa, vomiting and cramps, on October 23rd, at 8.30 p.m. During the day she had been in her usual health and had washed certain articles belonging to her sister noted above, who was still suffering from diarrhœa. During the night the symptoms increased in severity, and the patient lost her voice and became collapsed. On October 24th, about 11.30 a.m., she died. During the earlier stages the evacuations are stated to have been yellow in colour, and later as watery and very profuse. A portion of the ileum of this case was forwarded to Dr. Klein for bacteriological examination (*see* Appendix B., page 186, Material LV.). Dr. Klein reported the results of his cultivations as typical of true cholera. No further cases were reported from this district.

Keighley.

On October 16th, Dr. Gornall, the Medical Officer of Health for *Warrington* (Lancashire), reported the notification of a suspicious case of "cholera nostras," which proved fatal the same day. The history of the case, as supplied by Dr. Gornall, is as follows:—T. J., aged 30, a navvy employed on the Manchester Ship Canal, came to Warrington, from Barton-upon-Irwell, on October 13th and took lodgings at a common lodging-house in the butter market. T. J. did not sleep at the lodging-house on the evening of the 13th, but is supposed to have slept in the fields. He stated that his illness began on the evening of October 13th with diarrhœa and great pain. On October 14th he suffered from slight sickness and from constant diarrhœa. The following day, October 15th, this diarrhœa still continued, and on October 16th, there being no improvement, he determined to go to the Workhouse for treatment, but became so ill on the way that he was taken to the surgery of a medical man, who at once notified the case to the Medical Officer of Health as suspicious of cholera, and he was thereupon admitted to the Fever Hospital. Upon admission, at

Warrington.

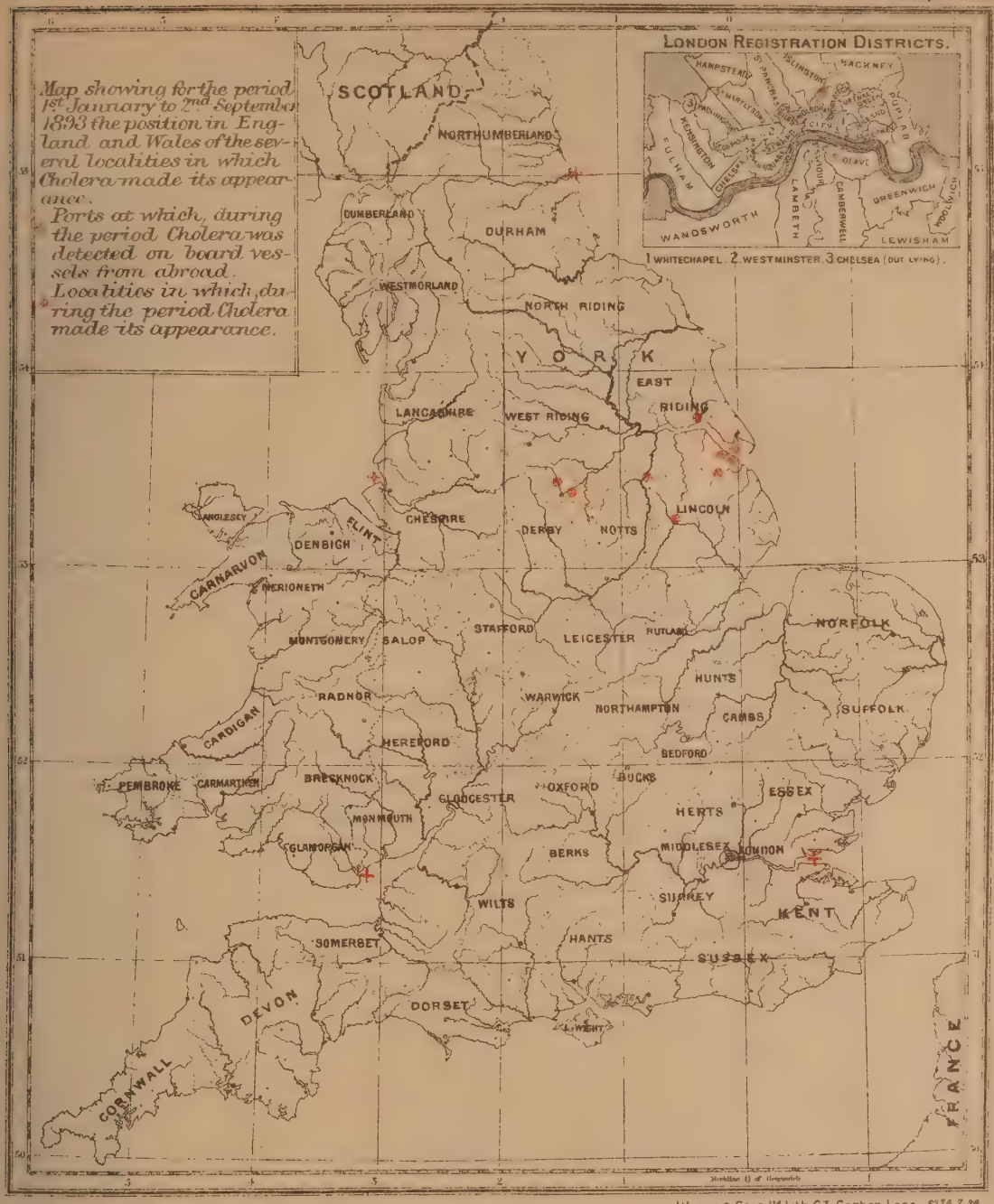
12.30 p.m., his temperature was 95° Fahr.; pulse very small; extremities cold with blueness of limbs; and patient apparently very weak. At 4 p.m., three motions since admission, fluid, brown, with a little solid matter in flakes; temperature 95° Fahr.; patient complained of pain, referred to epigastrium, sharp in character. Tongue furred, pointed; slight tenderness over most of the abdomen, chiefly referred to the left iliac fossa. At 8 p.m., temperature 92° Fahr.; no improvement. Six motions since 4 p.m.; patient still complained of pain and was very restless—"rice water" stools. The patient died suddenly at 10.15 p.m. Upon making a post-mortem examination at 10.30 a.m., on October 17th, it was observed that the body was that of a well-developed muscular man. The rigor mortis was well marked, the veins of the abdominal wall were injected, the intestines generally were congested, and the small vessels injected. A portion of the ileum was forwarded to Dr. Klein for bacteriological examination (*see* Appendix B., page 186, Material LIII.). Dr. Klein reported the result of the examination to be negative as regards comma-bacilli. The common lodging-house was cleaned and white-washed; all bedding, &c., destroyed; all excrement and refuse removed and burnt in the destructor. No further cases were reported.

Bingley.

On October 16th, a woman residing at Ingrow, in the *Bingley* (Township) Urban Sanitary District (Yorkshire), was attacked with choleraic symptoms and died the same day. The following notes, with respect to this case, were supplied by Dr. G. R. MacGregor, the Medical Officer of Health. E. B., female, aged 62 years, married, residing at Damems Road, Ingrow, was seized on October 16th with sickness, diarrhœa, cramps in limbs and abdomen, followed by general collapse; tha patient died eight hours after the commencement of her illness. A portion of the ileum was forwarded to Dr. Klein for bacteriological examination. (*see* Appendix B. page 186, Material LIV.). Dr. Klein reported that the results of his culture experiments were indicative of true cholera. Prior to her illness the patient had been engaged in nursing a person (L. D.) at Keighley, who died on October 13th under similar circumstances, and a history of whose illness has already been given (*see* p. 45). All the clothing and bed linen were destroyed and the house thoroughly disinfected, and no further cases were reported from this district.

CHOLERA IN ENGLAND AND WALES 1893.

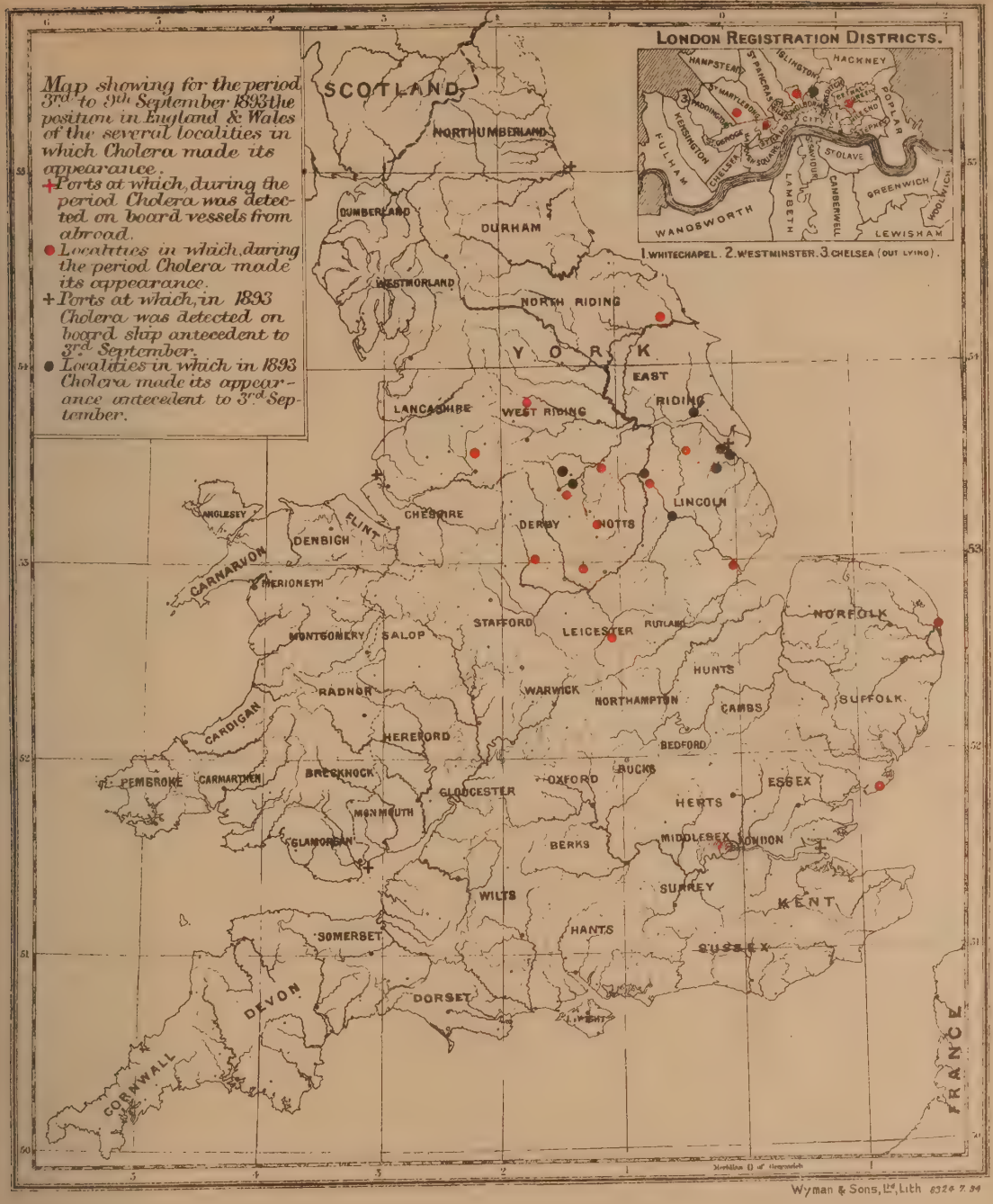
Map III.



Wyman & Sons, Ltd., Lith., 63, Carter Lane. 6326 7.94

CHOLERA IN ENGLAND AND WALES 1893.

Map IV.



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Cholera in England and Wales 1893.

Map V.

Wyman & Sons, Ltd, Lith 6324 7.94

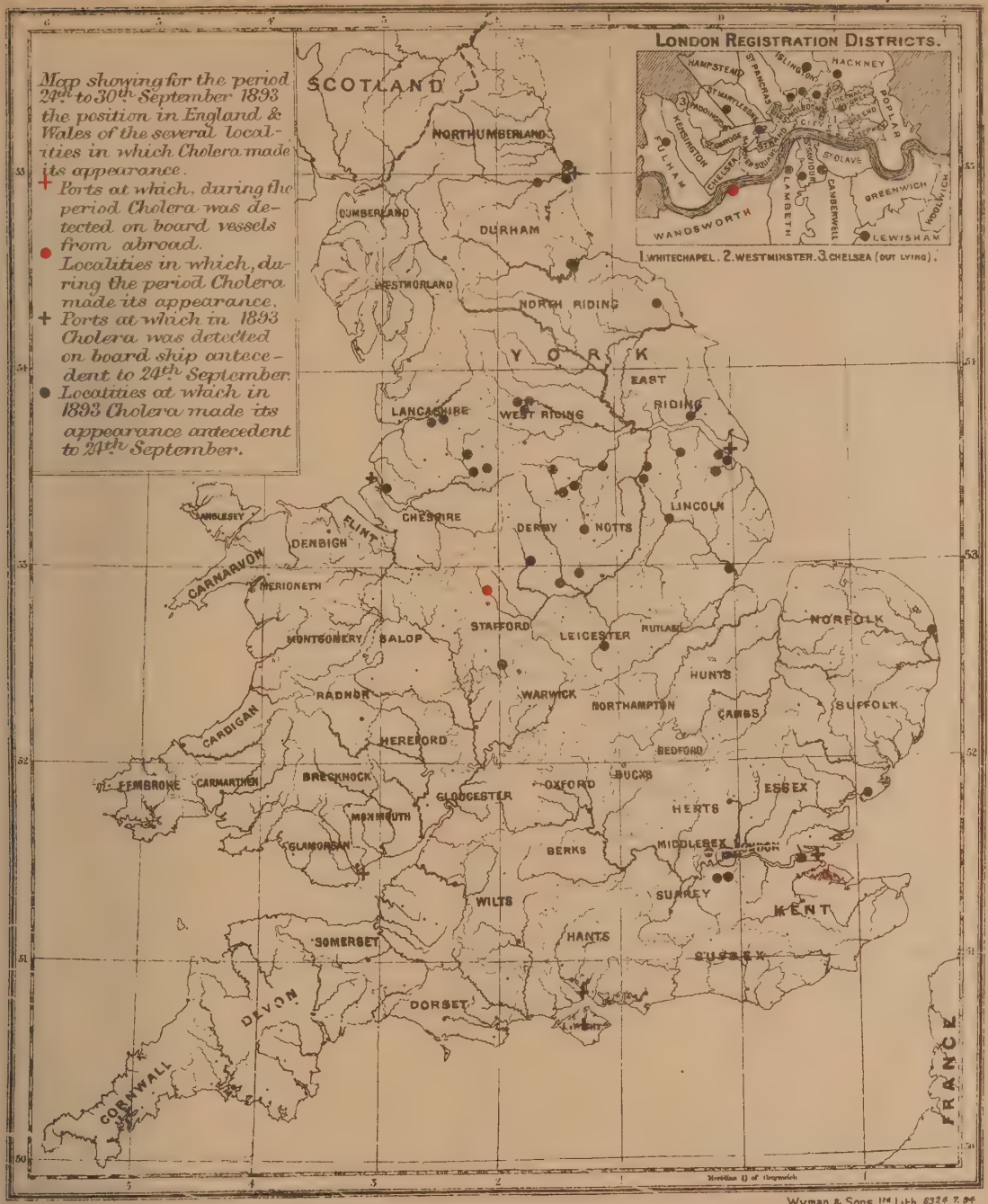
Cholera in England and Wales 1893.

Map VI.

Wyman & Sons Lt. Lith 63, Carter Lane.

CHOLERA IN ENGLAND AND WALES 1893.

Map VII.



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CHOLERA IN ENGLAND AND WALES. 1893.

Map VIII.

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No. 2.

Report on Cholera in 1893 in the Borough of Great Grimsby and in the Local Board District of Cleethorpe-with-Thrunscoe; by Dr. Reece.

In consequence of information having been received by the Board of the repeated occurrence in the Great Grimsby Urban Sanitary District during the month of August of illness with symptoms resembling cholera, and of the circumstance that three persons had died of such disease in the period August 11th to August 20th, I was, on August 29th, instructed to proceed forthwith to Grimsby to investigate the nature and extent of the current malady, and to advise the Sanitary Authority respecting it.

I arrived at Grimsby on the evening of August 29th, and at once placed myself in communication with Dr. Newby, Medical Officer of Health, and Mr. Alderman Jacob K. Marshall, the Chairman of the Sanitary Committee. From these gentlemen I learnt that several further deaths had occurred since the 20th of the month which had been referred to "cholera nostras," and that these persons had already been buried. A fresh case, that of Mrs. P——, of Trinity Square, being notified during the night of August 29th, I went with Dr. Newby to the house of the patient, accompanied by Mr. C. Byron Turner, the medical practitioner in charge of the patient. In its clinical aspects this case was undistinguishable from Asiatic Cholera. The patient died early on the morning of the 30th August, and Mr. C. Byron Turner and Dr. Newby performed a post-mortem examination. A portion of the lower bowel of this case was transmitted to Dr. Klein for bacteriological examination, and he reported to the Board by telegram that the material sent him gave indication that this person had suffered from true cholera. Hereupon I was instructed by the Board to make detailed investigation of the outbreak, and of the conditions under which it had occurred.

Also I received information that the death of a woman, aged 26, had occurred on August 15th, at 28, Harrington Street, which street is in that part of the Cleethorpe-with-Thrunscoe Urban Sanitary District which is practically an extension of and just outside Grimsby town towards the east and south. This case, though probably belonging etiologically to Grimsby, will henceforward be allotted to Cleethorpes, to which statistically it belongs.

Accordingly I was instructed to extend my investigations to the Cleethorpe-with-Thrunscoe Urban Sanitary District.

Up to this date, 30th August, there had (as was subsequently ascertained) occurred in Grimsby, including the port district, 15 deaths referable to disease of the nature of cholera, as follows:—

Number of Death.	Date.	Name.	Sex.	Age.	Residence.	Duration of Disease.	Remarks.
1	Aug. 3rd	J. J. O.	M.	35	Engineer of S.S. "Dania."	4 days	Died in hospital ship of the Port Sanitary Authority.
2	„ 11th	F.	M.	49	59, Trinity Street	40 hours	A dock labourer. Supper of cockles the night before his death.
3*	„ 19th	G. R.	M.	16	92, Park Street	14 hours	He had been employed at the Ice House near the docks.
4*	„ 20th	W. P.	M.	13	106, Grafton Street	12 hours	Died without receiving medical attendance.

* Death in these cases was certified as due to "diarrhœa." I have added them to the list, as from the history of the cases, their brief duration, and their fatal termination, I consider that they were probably cases of cholera.

App. A. No. 2.

On Cholera in Great Grimsby and Cleethorpes in 1892, by Dr. Rose.

Number of Death.	Date.	Name	Sex.	Age	Residence.	Duration of Disease.	Remarks.
5	Aug. 20th	Hn.	M.	41	Back of 44, Trinity Street.	24 hours	Master block maker at the fish docks, who drank [illegible] water which he had at his work. Said to have suffered from privation and want.
6	„ 20th	Ht.	F.	23	136, Rutland Street	28 hours	Supper of porter and fried fish.
7	„ 23rd	Wd.	M.	49	9, Trinity Square -	48 hours	Privation.
8	„ 24th	C.	M.	42	Back of 139, Hope Street (Charles Street).	24 hours	Coal heaver at the docks. Drank much water.
9	„ 26th	B.	F.	11	Fifth Terrace, Hope Street.	11 days	Doubtful case.
10	„ 26th	M.	F.	29	144, Willingham Street.	12 hours	——
11	„ 27th	Ws.	F.	47	29, Spencer Street	15 hours	——
12	„ 28th	Wd.	F.	19	9, Trinity Square -	56 hours	Daughter of case 7.
13	„ 28th	Hwt.	M.	10	56, Acton Street -	21 hours	——
14	„ 29th	A child	?	2	Frazer Street -	9 hours	——
15	„ 30th	P.	F.	36	8 Trinity Square -	—	Nursed the baby of the Wd. family at No. 9, Trinity Square, while the father and daughter were ill.

In Cleethorpe-with-Thrunscoe Urban Sanitary District, in addition to the death on August 15th mentioned above, there had occurred at the same date (August 30th) two deaths from like cause, viz. :—

No.	Date.	Name.	Sex.	Age.	Residence.	Duration of Disease.	General Remarks.
1	Aug. 27th	N. C.	M.	76	Mill Road - -	7 days	Was taken ill at sea.
2	„ 29th	M. F.	F.	74	Fairfield House -	14 days	——

In order to elucidate the account now about to be given of the cholera prevalence in this part of England, it is necessary to describe shortly the two urban districts that were here involved.

The Great Grimsby Urban Sanitary District, with an estimated population of 54,000, is situated on the north-east coast of Lincolnshire, on the South Bank, and about seven miles from, the mouth of the Humber. The site of Grimsby is flat and low, lying but little above high-water mark. Much of the town is built on ground originally a marsh. Geologically, it is upon quaternary beds of warp and alluvium, under which is the Boulder Clay; between the Boulder Clay and the Chalk there is a more or less thin layer of gravel or sand. The Chalk forming the Lincolnshire wolds dips down before reaching the coast and passes under the Humber. A boring in Grimsby shows the Chalk at the depth of 66 feet.

Adjoining the Great Grimsby Urban Sanitary District, and south-east of it, is the Urban Sanitary District of Cleethorpe-with-Thrunscoe.

The portion of Cleethorpe-with-Thrunscoe Urban Sanitary District, (population 4,600) which abuts on the New Clee district of the Great Grimsby Urban Sanitary District, is thickly populated. It is practically a suburb of that town, which is extending an ever increasing distance into the Cleethorpes district. The village proper of Cleethorpes is situated more than a mile from New Clee, though the two places are

connected by a tramway, and by the Manchester, Sheffield, and Lincolnshire Railway, which has a station at Cleethorpes. During the summer months the population is largely increased by the influx of visitors. There is but little fishing trade; the chief industries being the letting of lodgings and the entertainment of "trippers," a large number of whom find their way to Cleethorpes. There are large oyster-beds situated off Cleethorpes where oysters are stored in preparation for sale, and these oysters are largely consumed by the visitors.

This village stands on the Boulder Clay, there being for the most part no alluvium or warp at the surface; beneath the clay is a layer of gravel and sand, below this gravel the Chalk.

For the purpose of facilitating comparison of the facts as to cholera prevalence in Grimsby and in Cleethorpes with those recorded by Dr. Theodore Thomson in regard of Hull, this report will deal *first* with Grimsby *then* with Cleethorpes under each of the headings adopted by Dr. Thomson, namely:—

I. Cholera and choleraic diarrhœa.
II. Diarrhœa.
III. Enteric fever.
IV. Distribution in *Time* of choleraic disease, diarrhœa, and enteric fever.
V. Distribution in *Area* of these diseases.
VI. Source of the cholera.
VII. Maintenance of cholera.
VIII. Sanitary administration.

I.—CHOLERA AND CHOLERAIC DIARRHŒA.

Grimsby.

The first death in the district in 1893 which was probably due to cholera occurred on board the hospital ship "Bradford." The patient was the engineer to the SS. "Dania," which arrived off Grimsby from Antwerp on August 2nd. He died the following night on the Port Sanitary hospital ship, and his death was registered as due to "choleraic diarrhœa." The corpse was landed to be buried, and conveyed direct to the Grimsby New Cemetery by the officers of the Sanitary Authority. The corpse, before burial, was wrapped in sheets soaked in carbolic acid, and quicklime was placed under and over the coffin in the grave. The "Dania" was sent to the Mooring Station and disinfected. No other person was sick on board, and the vessel on August 4th proceeded on her voyage to the North Sea.

The master of this vessel had come ashore in the ship's boat on the morning of his arrival, and after making inquiries, drove to the house of the Port Inspector of Nuisances, who returned with the master to the vessel. When the master landed, the Customs House Officers had not boarded the vessel, nor did they learn of his landing until long afterwards. It is supposed that the crew of the boat stayed in her while the master was ashore; but of this there is no definite knowledge.

Investigation undertaken to ascertain whether there had occurred in Grimsby antecedent to 2nd August, or between that date and August 11th, other cases which might have been of choleraic nature proved altogether negative. No such case could be discovered. Nor, after 11th August, were any cases heard of as having occurred before August 15th and 19th.

The fatal manifestations of choleraic disease in Grimsby subsequent to August 2nd as illustrated by *deaths* referred to cholera, cholera nostras, and choleraic diarrhœa, are recorded in the following table, Table I. A.

App. A. No. 2.

On Cholera in Great Grimsby and Cleethorpes in 1893; by Dr. Reece.

Table I. A.

Showing Deaths certified as due to Cholera, Cholera Nostras, and Choleraic Diarrhœa in Great Grimsby (Population estimated at 54,000) during the Period August 11th to October 8th, 1893.

No.	Date of Death.	Sex.	Age.	Duration of Disease.	Death Certificate.	Remarks.
1	Aug. 3rd	M.	35	4 days	Choleraic diarrhœa	Died in Port Hospital.
2	„ 11th	M.	49	40 hours	Cholera nostras.	—
3	„ 19th	M.	16	14 „	Diarrhœa	These cases were, I consider, cases of cholera.
4	„ 20th	M.	13	12 „	Diarrhœa	
5	„ 20th	M.	43	24 „	English cholera.	—
6	„ 20th	F.	23	24 „	Cholera nostras.	—
7	„ 23rd	M.	49	2 days	Cholera nostras.	—
8	„ 24th	M.	42	24 hours	English cholera.	—
9	„ 26th	F.	29	12 „	Cholera nostras.	—
10	„ 26th	F.	11	11 days	Cholera nostras.	—
11	„ 27th	F.	47	15 hours	Cholera nostras.	—
12	„ 28th	M.	10	21 „	Cholera nostras.	—
13	„ 28th	F.	19	56 „	Choleraic diarrhœa.	—
14	„ 29th	M.	2	2 days	Diarrhœa	Considered by Medical Officer of Health to have been a case of cholera.
15	„ 30th	F.	36	12½ hours	Cholera nostras	Bacteriologically examined by Dr. Klein, and by him regarded as true Cholera.
16	„ 31st	M.	25	Not stated	Cholera morbus	„ „
17	Sept. 1st	F.	42	24 hours	Cholera morbus	Had been nursing No. 20.
18	„ 2nd	F.	14	Not stated	Choleraic diarrhœa	Died in hospital.
19	„ 2nd	M.	89	2 days	Cholera nostras.	—
20	„ 2nd	F.	36	8 „	Cholera morbus	Suppression of urine 40 hours.
21	„ 3rd	M.	40	Not stated	Asiatic cholera	Died in hospital.
22	„ 4th	M.	54	12 hours	Cholera	Son suffering from cholera.
23	„ 5th	F.	58	7 days	Chronic diarrhœa	Considered by Assistant Medical Officer of Health to be cholera. Son sent to hospital.
24	„ 5th	F.	62	3 „	Choleraic diarrhœa	—
25	„ 6th	M.	33	4 „	Asiatic cholera.	—
26	„ 7th	F.	44	Not stated	Cholera.	—
27	„ 7th	M.	2	24 hours	Cholera	Died in hospital.
28	„ 9th	M.	83	8 days	Cholera nostras.	—
29	„ 9th	M.	67	24 hours	Choleraic diarrhœa.	—
30	„ 11th	M.	45	9 days	Cholera	Died during a relapse.
31	„ 11th	M.	50	5 „	Cholera	Died in hospital.
32	„ 12th	M.	51	12 hours	Cholera morbus.	—
33	„ 16th	M.	45	Not stated	Choleraic diarrhœa	Died in hospital.
34	„ 19th	M.	49	„	Cholera	Died in hospital.
35	Oct. 6th	M.	36	„	Cholera.	—
36	„ 8th	M.	48	53 hours	Cholera.	—

Thus the number of deaths from disease of the nature of cholera in Grimsby during August, September, and October amounted to 36 in all, corresponding to a death-rate from this cause of 0·66 per thousand of population.

In this respect, therefore, Grimsby suffered more heavily than Hull, in which town the death-rate last autumn from disease of this class did not exceed 0·08 per 1,000 population.

Also Grimsby suffered cholera earlier than Hull, as will be seen from the subjoined table giving the incidence in time of cholera-death in the two places.

Date in 1893.	Deaths from Cholera and Choleraic Diarrhœa in		Date in 1893.	Deaths from Cholera and Choleraic Diarrhœa in	
	Grimsby (population 54,000).	Hull (population 208,700).		Grimsby (population 54,000.)	Hull (population 208,700).
Aug. 3rd	1*	—	Sept. 10th	—	—
„ 4th	—	—	„ 11th	2	1
„ 5th	—	—	„ 12th	1	—
„ 6th	—	—	„ 13th	—	1
„ 7th	—	—	„ 14th	—	—
„ 8th	—	—	„ 15th	—	—
„ 9th	—	—	„ 16th	1	—
„ 10th	—	—	„ 17th	—	—
„ 11th	1	—	„ 18th		2
„ 12th	—	—	„ 19th	1	—
„ 13th	—	—	„ 20th	—	—
„ 14th	—	—	„ 21st	—	—
„ 16th	—	—	„ 23rd	—	—
„ 17th	—	—	„ 24th	—	2
„ 18th	—	—	„ 25th	—	1
„ 19th	1	—	„ 26th	—	1
„ 20th	3	—	„ 27th	—	—
„ 21st	—	—	„ 28th	—	—
„ 22nd	—	—	„ 29th	—	—
„ 23rd	1	—	„ 30th	—	—
„ 24th	1	1	Oct. 1st	—	—
„ 25th	—	—	„ 2nd	—	—
„ 26th	2	—	„ 3rd	—	—
„ 27th	1	—	„ 4th	—	—
„ 28th	2	—	„ 5th	—	—
„ 29th	1	—	„ 6th	1	—
„ 30th	1	—	„ 7th	—	—
„ 31st	1	—	„ 8th	1	—
Sept. 1st	1	1	„ 9th	—	—
„ 2nd	3	—	„ 10th	—	1
„ 3rd	1	2	„ 11th	—	—
„ 4th	1	1	„ 12th	—	—
„ 5th	2	—	„ 13th	—	—
„ 6th	1	2	„ 14th	—	—
„ 7th	2	1	„ 15th	—	—
„ 8th	—	—	„ 16th	—	—
„ 9th	2	—	„ 17th	—	—
			Total -	36	17

* The case previously mentioned as having been brought to the district by the S.S. "Dania."

Information as to *non-fatal* diarrhœal sickness in Grimsby was obtained as follows:—

On August 25th the Sanitary Authority requested, by circular, the medical practitioners of Grimsby to notify cases of a choleraic character.

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This not producing the desired effect, on August 31st the Sanitary Authority decided to pay a fee of 2*s.* 6*d.* for each case notified, and a fee of 5*s.* for each case of diarrhœa prescribed for by the medical practitioners of the town; and they at once took steps for duly advertising their decision.

On September 1st notification of cases of "diarrhœa" was requested, the fee for such notification being 2*s.* 6*d.*; few cases were however notified until September 5th, and on September 6th choleraic diarrhœa became by a special order of the Board (issued under the Epidemic Regulations) compulsorily notifiable, in the urban district and port of Grimsby. The request of the Sanitary Authority for notification of diarrhœa was cancelled on September 11th, the fee being withdrawn at the same time. A few cases were however notified up to the morning of September 13th. The fee of 5*s.* for prescription for diarrhœa was withdrawn on September 23rd. Meanwhile notification of choleraic disease remained in force until the withdrawal of the Epidemic Regulations on January 8th, 1894. "Cholera" was notified throughout in accordance with the provisions of a local Act, which practically coincides with the Infectious Disease (Notification) Act, 1889. In addition to information thus acquired, the Sanitary Authority gained knowledge of cases of choleraic disease through their officers and in other ways.

All such cases, however ascertained, were investigated by the Medical Officer of Health or Assistant Medical Officer of Health, and as a result I am furnished with the following list of total cases of disease of choleraic nature. It does not profess to be exhaustive, and it includes fatal with non-fatal cases.

Table II. A.

Showing, day by day, the Number of Cases regarded as of the Nature of Cholera that occurred in Grimsby during the Period August 11th to October 14th, 1893.

Date.	No. of Persons attacked.	Died on Date in Col. 1.	Date.	No. of Persons attacked.	Died on Date in Col. 1.
Aug. 3rd		1	Sept. 8th	11	—
,, 11th		1	,, 9th	3	2
,, 19th		1	,, 10th	—	—
,, 20th		3	,, 11th	9*	2
,, 21st	8	—	,, 12th	1	1
,, 22nd		—	,, 13th	2	—
,, 23rd		1	,, 14th	2	—
,, 24th		1	,, 15th	3	—
,, 25th		—	,, 16th	1	1
,, 26th	7	2	,, 17th	2	—
,, 27th	3	1	,, 18th	2	—
,, 28th	1	2	,, 19th	2	1
,, 29th	1	1	,, 20th	1	—
,, 30th	1	1	,, 21st	1	—
,, 31st	1	1	,, 22nd	2	—
			,, 23rd	—	—
Sept. 1st	6	1	,, 24th	—	—
,, 2nd	14*	3	,, 25th	—	—
,, 3rd	3	1	,, 26th	—	—
,, 4th	6	1	,, 27th	—	—
,, 5th	9	2	,, 28th	—	—
,, 6th	7	1	,, 29th	—	—
,, 7th	6	2	,, 30th	—	—

* One case occurred on the shipping in the Alexandra Dock, and is hereafter included in the North-West Ward, in which ward the Alexandra Dock is situated.

Date.	No. of Persons attacked.	Died on Date in Col. 1.	Date.	No. of Persons attacked.	Died on Date in Col. 1.
Oct. 1st	—	—	Oct. 9th	1	—
„ 2nd	—	—	„ 10th	1	—
„ 3rd	—	—	„ 11th	—	—
„ 4th	—	—	„ 12th	—	—
„ 5th	1	—	„ 13th	—	—
„ 6th	—	1	„ 14th	1	—
„ 7th	4	—			
„ 8th	—	1	Total -	128	36

The apparent sudden increase of cases coming under notice at the beginning of September was due no doubt to the fact that at this date notification of choleraic diarrhœa carried with it a fee, which it had not hitherto done ; and it is probable, too, that a certain proportion of cases notified at this time as matter of fact occurred at a date antecedent to that at which they were recorded. So that the seeming high fatality of attacks recorded in August becomes to a corresponding degree discounted. On the other hand, the smaller fatality of attacks in September is perhaps referable to inclusion among the notifications in this month of cases not truly choleraic. But taking the figures as a whole the total of 36 deaths among 128 recorded cases, *i.e.*, a fatality of nearly 28 per cent., is a strong indication that the majority of cases notified as choleraic illness were in all probability examples of true cholera. In this respect Grimsby is in contrast with Hull, where the fatality of the recorded choleraic illness amounted to no more than 20 per cent., and this different fatality of the current cholera in the two places affords further indication of the far heavier incidence of true cholera on Grimsby than on Hull, which has already been adverted to.

Cleethorpe-with-Thrunscoe.

The first fatal case from disease of the nature of cholera, as far as could be ascertained, in this district was that of the woman, aged 26, who died on August 15th, after an eight hours' illness, at 28, Harrington Street, New Clee, a street which is situated in that part of the district which is really an extension of the town of Grimsby. Prior to this date there had been, in 1893, no deaths in Cleethorpes ascribed to choleraic disease, and none occurred later than September 8th.

The manifestations of disease of the nature of cholera as shown by the *deaths* recorded in the Urban Sanitary District were as follows :—

Table I. B.

Showing Deaths certified as due to Cholera, Cholera Nostras, and Choleraic Diarrhœa in the Cleethorpe-with-Thrunscoe Urban Sanitary District (Population estimated at 4,600) during the Period, August 15th to September 8th, 1893.

No.	Date of Death.	Sex.	Age.	Duration of Disease.	Death Certificate.	Locality.
1	Aug. 15	F.	26	8 hours -	Cholera nostras -	New Clee, adjacent to boundary of Grimsby.
2	„ 27	M.	76	7 days -	Diarrhœa - -	In the village of Cleethorpes.
3	„ 29	F.	74	14 „ -	Diarrhœa -	„ „
4	Sept. 1	M.	45	6 „ -	Choleraic diarrhœa -	„ „
5	„ 2	F.	86	2 „ -	Choleraic diarrhœa -	„ „
6	„ 2	M.	56	12 hours -	Cholera - -	„ „
7	„ 8	M.	28	2 days -	Cholera morbus -	„ „

These seven fatal cases correspond to a death-rate in Cleethorpes of 1·52 per thousand in a population of some 4,600.

As to *non-fatal* cases, the Infectious Disease (Notification) Act, 1889, is not in force in the Cleethorpe-with-Thrunscoe Urban Sanitary District; the Sanitary Authority, although recommended by the Local Government Board to adopt the Act, have not done so.

Public notice that cholera and choleraic diarrhœa, had become compulsorily notifiable in Cleethorpes, as at Grimsby under the Epidemic Regulations of September 1st and 6th, was not issued by the Sanitary Authority of the district until September 8th. Meanwhile, however, information respecting occurrence of disease of choleraic nature had since the beginning of the month been obtained by the Medical Officer of Health from the medical men practising in the place; and with the result shown in the subjoined table.

TABLE II. B.

SHOWING, day by day, the NUMBER of CASES regarded as of the NATURE of CHOLERA that occurred in the CLEETHORPE-WITH-THRUNSCOE URBAN SANITARY DISTRICT during August and part of September 1893.

Date in 1893.	Number of Persons attacked by Choleraic Diseases.	Died on Date.	Date in 1893.	Number of Persons attacked by Choleraic Disease	Died on Date
Aug. 1st	—	—	Aug. 24th	—	—
,, 2nd	—	—	,, 25th	1	—
,, 3rd	—	—	,, 26th	—	—
,, 4th	—	—	,, 27th	1	1
,, 5th	—	—	,, 28th	—	—
,, 6th	—	—	,, 29th	—	1
,, 7th	—	—	,, 30th	—	—
,, 8th	—	—	,, 31st	1	—
,, 9th	—	—	Sept. 1st	—	1
,, 10th	—	—	,, 2nd	1	1
,, 11th		—	,, 3rd	1	—
,, 12th	—	—	,, 4th	—	—
,, 13th	—	—	,, 5th	—	—
,, 14th	—	—	,, 6th	1	—
,, 15th	1*	1*	,, 7th	1	—
,, 16th	—	—	,, 8th	1	1
,, 17th	—	—	,, 9th	—	—
,, 18th	—	—	,, 10th	—	—
,, 19th	—	—	,, 11th	—	—
,, 20th	1	—	,, 12th	—	—
,, 21st	—	—	,, 13th	—	—
,, 22nd	—	—			
,, 23rd	—	—	Total -	11	7

* The fatal case already referred to, on the first page of this report, as occurring at Harrington Street, New Clee, in the suburbs of Grimsby.

From the above table it appears that, during the period August 15th to September 8th, 11 persons were within the knowledge of the

Sanitary Authority attacked by an illness judged to be choleraic in nature.

Cleethorpes, too, like Hull, suffered later than Grimsby, all of its cholera, except the case referred to as etiologically belonging to Grimsby, occurring in late August or early September.

II.—DIARRHŒA.

Grimsby.

The amount and the nature of "Summer Diarrhœa" in Grimsby in 1893 was also duly inquired about, not only with a view to ascertaining whether this disease had been unusually prevalent, but also for the purpose of determining whether true cholera, that had proved fatal, had not been in part included in the diarrhœa mortality.

Amount of Diarrhœa in Grimsby in 1893.

The amount of diarrhœa in Grimsby in 1893 is to be judged of in two ways; namely, by the number of deaths attributed to this cause, and by the diarrhœa attacks which came to the knowledge of the Great Grimsby Sanitary Authority during the period in which this malady was being notified

The total number of *deaths* ascribed to diarrhœa in Grimsby in 1893 was 125, which, the estimated population of Grimsby in 1893 being 54,000, gives a mortality from this cause of 2·3 per thousand persons living. Compared with the rate from the same cause in the 28 large towns of England and Wales during the ten years 1883–1892, which was 0·82 per thousand living, the Grimsby rate was exceptionally high.

But, as has been shown by Dr. Theodore Thomson, the diarrhœa death-rate was in 1893 unusually high throughout the country, and, accordingly, it is necessary, for just appreciation of the position of Grimsby in that year, to compare Grimsby with itself in this respect as regards former years, and the diarrhœa death-rate of the Urban Sanitary District in 1893 with that for other towns in the same year. In the absence of figures for complete comparison in the above sense for the whole year 1893, a table published by the Registrar General in his return for the third quarter of each year will suffice. It is in this quarter that by far the greater number of deaths from diarrhœa occurs in this country; and in this way, therefore, a sufficiently just means of comparison of diarrhœa incidence on various town districts is afforded. On the data thus provided is based the following table, Table III. A., in which is shown the diarrhœa death-rate in Grimsby in the third quarter of 1893, as well as in the ten years 1883–1892. Also the table affords means of comparison in this respect of Grimsby with Hull and with other towns as well as with England and Wales.

Table III. A.

Showing (as an Annual Rate) for Grimsby, Hull, England and Wales, "28 great Towns" and "67 other large Town-Districts," the Diarrhœa Mortality in the Third Quarter in each of the Eleven Years 1883–1893; and giving in each Instance, for comparison with 1893, the Mean of the Third Quarter Rates of the Ten Years 1883–1892.

Third Quarter of the Year.	Rate per 1,000 Population in each Instance.				
	Grimsby.	Hull.	England and Wales.	Great Towns.	Other large town Districts.
1883 - -	1·2	1·8	1·2	2·1	1·4
1884 - -	6·7	6·0	2·7	4·0	3·2
1885 - -	0·4	0·8	1·1	2·1	1·0
1886 - -	5·4	4·5	2·3	3·7	2·6
1887 - -	5·5	4·1	2·1	3·4	2·2
1888 - -	2·5	0·9	0·9	1·6	1·0
1889* - -	4·0	4·0	1·7	2·6	2·0
1890 - -	5·4	2·6	1·3	2·1	1·4
1891 - -	1·5	1·9	1·0	1·7	1·0
1892 - -	3·9	2·9	1·2	2·0	1·5
Average in 10 years, 1883–92	3·6	3·0	1·6	2·5	1·7
1893 - -	8·7	8·4	2·8	3·5	3·5

* In this year the boundary of the Great Grimsby Urban Sanitary District was altered and considerably increased.

From these figures it will be seen that the average death-rate from diarrhœa in Grimsby exceeds that of Hull, and is, moreover, considerably higher than the corresponding rates for England and Wales, for the "28 large towns," and for the "67 other large town-districts." Further it appears that the diarrhœa mortality in the third quarter of 1893 was increased in each of the areas under comparison, and that the diarrhœa death-rate was greatest of all in Grimsby. So far, therefore, as conclusion regarding prevalence of diarrhœa sickness may be arrived at from mortality from this cause, it would appear that Grimsby in this respect suffered in the third quarter of 1893, not only more than was usual in that borough, but also relatively more than did the remainder of the country, and to a greater extent even than its neighbour Hull on the other side of the Humber.

As to diarrhœa prevalence in the autumn of 1893, the facts as to the recorded number of diarrhœa *attacks* day by day during the period of September 1st to September 13th, during which the Sanitary Authority paid a fee for the notification of this malady, are given in the following table, Table IV. A.

TABLE IV. A.

SHOWING, Day by Day, the NUMBER of PERSONS known to have been attacked by DIARRHŒA in GRIMSBY during the Period September 1st to September 13th, 1893.

Date.	Number of Persons attacked.	Date.	Number of Persons attacked.
September 1st	2	September 8th	68
„ 2nd	1	„ 9th	65
„ 3rd	4	„ 10th	56
„ 4th	0	„ 11th	58
„ 5th	9	„ 12th	63
„ 6th	30	„ 13th	9
„ 7th	111	Total	476

Anterior to the time (September 1st) when medical practitioners commenced to notify diarrhœa sickness, there had been a large amount of diarrhœa in Grimsby, and, accordingly, the statistics as to diarrhœa sickness during the period September 1st to September 13th, represent a fraction only of the total diarrhœa sickness in Grimsby in the autumn of 1893. Nevertheless they suffice to show that during the period in which choleraic disease chiefly prevailed in Grimsby diarrhœa was also very abundant there. In the particular week September 6th to September 12th inclusive, the number of diarrhœa cases notified was 451; equal to a rate *annually* of 434 per thousand of the population.

In view of the demonstrated excess of diarrhœa in Grimsby in the third quarter of 1893, it is desirable to consider whether this unusual prevalence of the malady was accompanied by departure from the type of the ordinary summer diarrhœa in this country, which tends, as is well known, to be fatal mainly among infants.

Age Distribution of Deaths from Choleraic Disease and Diarrhœa in Grimsby in 1893.

The 36 deaths ascribed in Grimsby to disease of the nature of cholera and the 125 deaths referred to diarrhœa are classified in the following Table V. A. in certain age groups.

TABLE V. A.

Showing NUMBER of DEATHS attributed respectively to DISEASE of the NATURE of CHOLERA and to DIARRHŒA in the GREAT GRIMSBY URBAN SANITARY DISTRICT in 1893: classified according to Age.

Age Period.	No. of Deaths due to Disease of the Nature of Cholera.	No. of Deaths due to Diarrhœa.
Under 1	—	98
1–5	2	17
5–15	3	2
15–60	27	4
Over 60	4	4
At all ages	36	125

App. A. No. 2.

The above figures show that of reputed cholera deaths in Grimsby upwards of 90 per cent. were at ages *over* five years; and that on the other hand, of deaths in the town ascribed to diarrhœa, more than 90 per cent. were at ages *under* five years. This wholly different incidence on age of the one and the other accepted cause of death is not inconsistent with the fatal malady, reputed to be cholera, having been true cholera, and with the fatal diarrhœa having been in the main, not cholera, but the ordinary summer diarrhœa of this country. At the same time it affords no sufficient basis for inference that much of the fatal diarrhœa of the third quarter of 1893, which affected infants, was not after all of the nature of true cholera.

As to the precise nature of *non-fatal* diarrhœa in Grimsby in 1893, no trustworthy information is forthcoming with reference to that occurring antecedent to the appearance of cholera in the town. During prevalence of cholera, however, cases of illness made their appearance which, in view of the circumstances under which they occurred, locally obtained the name of "infective diarrhœa." Some of these cases were seemingly notified indifferently as "choleraic diarrhœa" and as "diarrhœa"; but others were not, so far as I could ascertain, notified at all. The class of diarrhœa now in question is indicated by the following notes taken in regard of particular cases.*

Case I.—M.A.B., 51 years of age, had been attacked on August 2nd by vomiting and purging, which lasted a day or two and left her in a weak condition. On September 9th she was again attacked, the onset being ushered in by vomiting and purging, followed by cramps in the legs and abdomen; extremities cold. The patient remained in this condition for 24 hours; the vomit and stools became "frothy"; gradually reaction set in and diarrhœa ceased on September 19th. Very little urine was passed during the first few days of the illness. Her hearing became impaired during the attack, and it remained so afterwards. No satisfactory explanation of her illness was forthcoming. Her husband, a joiner, had assisted at the end of August and the early part of September in placing in their coffins the bodies of certain patients who had died from cholera. He suffered from malaise afterwards, and had pains in the head and abdomen, but no diarrhœa.

Case II.—E.P., aged 18 years, 15, Bridge Street. On September 9th she visited M.A.B., Case I. On September 13th she came home to dinner as usual, and after partaking of her dinner of meat and potatoes, she ate a raw potato and returned to her work (trawl net braiding). She was quite well at 2 p.m. Soon after commencing work she was attacked with cramps in her right calf, pains in lower hypogastric region, followed by diarrhœa, stools soon becoming "watery." She walked home, on the way she vomited three times in the street, the vomit being "watery fluid." On her arrival home she was placed in bed; the extremities were then cold, face pinched and dusky. This condition continued until the next day, September 14th, when she perspired copiously. No urine was passed between the time of the attack on 13th and the morning of September 15th. On September 16th temperature rose to 100° F. On September 18th she got up convalescent.

Case III.—A.P., aged 23, 15, Bridge Street, nursed the preceding case. On September 16th, 3 a.m, she vomited and went to stool five times, but suffered no pain. At 9.30 a.m. seized with cramp in abdomen and chest. Extremities became cold and legs drawn up to the body. There was severe headache and buzzing in the ears. Face cyanozed. No urine was passed between September 17th and 21st. Diarrhœa and vomiting ceased on September 17th. She was able to sit up on September 20th, when she presented a very anæmic and emaciated appearance.

* For the notes of these cases I am indebted to Mr. Pryce Jenkins, one of the Medical Visitors.

Case IV.—E.B., 19 years. Living in the same house as Case I. Was attacked on September 16 at 8 a.m. with diarrhœa and vomiting. Cramps in abdomen and legs set in during the day. Legs rigidly drawn up. Extremities cold. Severe headache and buzzing in the ears. No urine passed on 16th and 17th, when the patient began to convalesce.

Case V.—E.P., age 57, of 15, Bridge Street, assisted to nurse Cases II. and III., E.P. and A.P. On September 18th she had a feeling of malaise and went to bed in the afternoon. On September 19th she was attacked with diarrhœa and vomiting and pains in the limbs, the extremities were cold, and she complained of dizziness in the head. Diarrhœa ceased on September 20th.

It would appear that cases of diarrhœa of this description were cases of cholera of a mild type; and the following account of similar disease, occurring in the shipping, is confirmatory of this.

On September 1st a sailor on board the Norwegian sailing ship "Elizabeth," lying in the Alexandra Dock, was attacked with symptoms of cholera and removed to the "fever" hospital. Vessels unloading in the Alexandra Dock are principally timber vessels, and the vessels stay in dock several days while the process of unloading the timber is being carried on. The ship "Elizabeth" had arrived from Sweden on 27th August. The sailor in question had been on shore at Grimsby the night of August 31st. This vessel was not removed from the dock, but disinfected where she lay. In the next few days two members of the crew were similarly attacked by diarrhœa, vomiting, and cramp. They quickly recovered, being only ill a few hours, but for the time they suffered from most of the symptoms of cholera in a mild degree. They were not removed from the vessel.

Diarrhœa subsequently made its appearance in one ship after another lying in the Alexandra Dock, attacking a large per-centage of the various crews; in one case as many as 14 on a single vessel, the entire crew. It also appeared on board vessels in the Union Dock, which is continuous with the Alexandra Dock, the two docks being only separated in name. Most of the vessels lying in these docks were attacked. Also at this time there was a certain amount of diarrhœa on board the fishing smacks. As a rule the fishermen do not remain on their vessels, but leave them as soon as they reach dock and go to their homes in Grimsby or Cleethorpes. Some cases of diarrhœa of a severe type occurring in fishermen in the town became known to the Sanitary Authority, but from the habits of the sailors it is quite possible that many cases occurred in which medical assistance was not sought.

Cleethorpe-with-Thrunscoe.

The total number of *deaths* ascribed to diarrhœa in the Cleethorpe-with-Thrunscoe Urban Sanitary District in the third quarter of 1893 was 12, which, the estimated population of the district in 1893 being 4,600, gives a mortality from this cause of 10·4 *annually* per thousand persons living. This rate is six to seven times the average rate (1·6) in Cleethorpes in the third quarter of the preceding three years, and, moreover, it greatly exceeds the corresponding rates in 1893 for Grimsby and Hull, and for other towns. Comparison of the rates in question is afforded in the following table (III. B.).

TABLE III. B.

Third Quarter of Year.	Diarrhœa Death-rate per 1,000 Population in each Instance.				
	Cleethorpes.	Grimsby.	Hull.	Great Towns.	Other large Towns.
Average 1890-92 -	1·6	3·6	2·5	1·9	1·3
„ 1893 -	10·4	8·7	8·4	3·5	3·8

There can be no question, therefore, that Cleethorpe-with-Thrunscoe suffered exceptionally in the third quarter of 1893 from fatal diarrhœa.

As to the nature of this excess of diarrhœa in Cleethorpes in the third quarter of 1893, nothing for certain is known. The facts, as to age distribution, show that the deaths referred in 1893 to diarrhœa were, as in Grimsby, most abundant at ages under 5 years.

TABLE V. B.

SHOWING the NUMBER of DEATHS attributed respectively to DISEASE of the NATURE of CHOLERA and to DIARRHŒA in the CLEETHORPE-WITH-THRUNSCOE URBAN SANITARY DISTRICT in 1893: classified according to the Age.

Age Period.	No. of Deaths due to Disease of the Nature of Cholera.	No. of Deaths due to Diarrhœa.
Under 1 - -	1	11
1–5 - - -	—	1
5–15 - -	—	—
15–60 - - -	3	1
Over 60 - -	3	—
At all ages -	7	13

As to *non-fatal* diarrhœa in Cleethorpes, no definite account can be given since "diarrhœa" was not notifiable there at any time. The number of attacks that came to the knowledge of the Sanitary Authority are likely to have fallen considerably short of those which actually occurred, but so far as is known the "diarrhœa" cases occurring day by day between September 1st to September 13th (the period dealt with as regards Grimsby) numbered 29. The ages of these persons are not known, and other facts recorded respecting them are meagre; so that the precise nature of these attacks remains doubtful.

TABLE IV. B.

SHOWING, day by day, the NUMBER of PERSONS known to have been attacked by DIARRHŒA in the CLEETHORPE-WITH-THRUNSCOE URBAN SANITARY DISTRICT during the Period September 1st to September 13th, 1893.

Date.	No. of Persons attacked by Diarrhœa.	Date.	No. of Persons attacked by Diarrhœa.
September 1st	—	September 9th	—
„ 2nd	—	„ 10th	4
„ 3rd	—	„ 11th	3
„ 4th	—	„ 12th	1
„ 5th	—	„ 13th	1
„ 6th	4		
„ 7th	—	Total	29
„ 8th	16		

III.—ENTERIC FEVER.

GRIMSBY.

In Grimsby in 1893 the number of cases of enteric fever notified to the Sanitary Authority as having occurred in the district was 326, and the deaths referred to this cause in the course of the year were 54.

In Grimsby in 1893 therefore 60·4 out of every 10,000 persons living were attacked by enteric fever, and 10 out of every 10,000 persons died of this disease. The following figures afford means of contrasting these rates with corresponding rates for other places and for Grimsby itself in other years:—

Sickness	*Grimsby:* Sickness-rate from enteric fever per 10,000 of population in 1893	60·4
	Hull: Sickness-rate from enteric fever per 10,000 of population in 1893	32·0
	41 *Notification towns:* Sickness from enteric fever per 10,000 of population in 5 years 1883–87	14·0
Mortality	*Grimsby:* Death-rate from enteric fever per 1,000 of population in 1893	1·00
	Hull: Death-rate from enteric fever per 1,000 population in 1893	0·43
	Grimsby: Death-rate from "fever"* per 1,000 population in the years 1882–91	0·42
	Hull: Death-rate from "fever"* per 1,000 population in the years 1882–91	0·26
	Twenty-eight large towns: Death-rate from "fever"* per 1,000 population in 10 years 1882–91	0·25

Hence it appears that not only did Grimsby suffer in 1893 a considerably greater amount of enteric fever than is usual in that borough, but that the attack-rate and the death-rate there from this cause was markedly greater than in Hull and in other towns.

* "Fever" includes, in addition to enteric fever, typhus and simple well-defined forms of continued fever.

Cleethorpe-with-Thrunscoe.

The amount of enteric fever in 1893 in the Cleethorpe-with-Thrunscoe Urban Sanitary District can only be judged of by the deaths from this cause. The Infectious Disease (Notification) Act, 1889, is not in force in the district.

The enteric fever deaths registered in 1893 amounted to 5, which gives a death-rate from this cause of 1·08 out of every thousand persons. Compared with the data for Grimsby and Hull the rate is a high one; but it is based on a small figure, and has, therefore, no great significance. Taken, however, with the facts respecting cholera and diarrhœa in the district, it fully supports the inference that alvine diseases were abnormally frequent in Cleethorpes in 1893.

IV.—DISTRIBUTION IN *TIME* OF DISEASE OF THE NATURE OF CHOLERA, OF DIARRHŒA, AND OF ENTERIC FEVER.

Grimsby.

Table VI. A. gives, week by week, for Grimsby the ascertained deaths ascribed to disease of the nature of cholera, and to diarrhœa respectively throughout the whole year; the ascertained attacks of choleraic disease during the period August 11th to October 14th; and the cases of enteric fever notified to the Sanitary Authority and the deaths from this cause throughout the whole year. *Vide* also Charts A. and B. in addendum to this report.

Table VI. A.

Showing Week by Week for 1893 the Number of Persons ascertained to have been attacked by Disease of the Nature of Cholera, and by Enteric Fever in Grimsby; as well as the Deaths in each week registered as due to Cholera Disease and to Diarrhœa in the same Borough.

Weekly Periods, 1893.	No. of Persons attacked by Disease of the Nature of Cholera.	No. of Deaths from Disease of the Nature of Cholera.	No. of Diarrhœa Deaths.	No. of Persons attacked by Enteric Fever.	No. of Deaths from Enteric Fever.
Week ending Jan. 7th.	—	—	—	1	—
,, ,, 14th.	—	—	—	2	1
,, ,, 21st	—	—	—	—	1
,, ,, 28th	—	—	—	—	—
,, Feb. 4th	—	—	—	1	—
,, ,, 11th	—	—	—	2	—
,, ,, 18th	—	—	—	1	1
,, ,, 25th	—	—	2	—	1
,, March 4th	—	—	—	—	—
,, ,, 11th	—	—	—	—	—
,, ,, 18th	—	—	—	—	—
,, ,, 25th	—	—	—	2	—

Weekly Periods, 1893.	No. of Persons attacked by Disease of the Nature of Cholera.	No. of Deaths from Disease of the Nature of Cholera.	No. of Diarrhœa Deaths.	No. of Persons attacked by Enteric Fever.	No. of Deaths from Enteric Fever.
Week ending April 1st	—	—	—	5	—
„ „ 8th	—	—	—	1	1
„ „ 15th	—	—	—	1	—
„ „ 22nd	—	—	—	1	1
„ „ 29th	—	—	—	1	—
„ May 6th	—	—	—	—	—
„ „ 13th	—	—	2	1	—
„ „ 20th	—	—	—	2	—
„ „ 27th	—	—	—	2	—
„ June 3rd	—	—	—	2	—
„ „ 10th	—	—	1	—	—
„ „ 17th	—	—	—	1	—
„ „ 24th	—	—	—	2	—
„ July 1st	—	—	1	4	—
„ „ 8th	—	—	—	3	—
„ „ 15th	—	—	3	3	—
„ „ 22nd	—	—	5	4	—
„ „ 29th	—	—	6	3	1
„ Aug. 5th	—	—	15	8	1
„ „ 12th	1	1	19	9	1
„ „ 19th	1	1*	24	14	2
„ „ 26th	12	7*	21	11	3
„ Sept. 2nd	27	10	10	30	1
„ „ 9th	49	9	7	24	3
„ „ 16th	18	4	2	20	5
„ „ 23rd	11	1	4	34	3
„ „ 30th	—	—	2	38	1
„ Oct. 7th	5	1	—	22	6
„ „ 14th	3	1	—	13	5
„ „ 21st	—	—	—	12	5
„ „ 28th	—	—	—	10	—
„ Nov. 4th	—	—	—	15	5
„ „ 11th	—	—	—	3	—
„ „ 18th	—	—	—	5	1
„ „ 25th	—	—	—	6	2
„ Dec. 2nd	—	—	—	2	1
„ „ 9th	—	—	—	—	—
„ „ 16th	—	—	1	—	—
„ „ 23rd	—	—	—	3	1
„ „ 30th	—	—	—	1	—
„ „ 31st	—	—	—	1	1
Totals - -	127	35†	125	326	54

* One death registered as diarrhœa has been added here as being probably of choleraic nature.
† In these statistics the death on board the port hospital ship of the engineer of the "Dania" is not included.

Table VI. A. and the charts A. and B. alike show that fatal diarrhœa attained its maximum in Grimsby just antecedent to the date at which disease of the nature of cholera and enteric fever began largely to prevail there. And further they show that enteric fever exhibited a sudden increase just antecedent to the prevalence of cholera and was maintained subsequently at a level considerably above the average for the year long after cholera had disappeared from the town. Chart B. further illustrates the above facts, and especially exhibits the abruptness of the rise and fall of disease regarded as of the nature of cholera as compared with the rise and fall of enteric fever.

Cleethorpe-with-Thrunscoe.

Similar comparisons for Cleethorpes of the behaviour in time of disease of the nature of cholera, of diarrhœa, and of enteric fever has to be based on death returns alone; the Notification Act not having been yet adopted in this district.

Table VI. B.

Showing, Week by Week, from August to December 1893 the Number of Persons ascertained to have died from Disease of the Nature of Cholera, of Diarrhœa, and of Enteric Fever in the Cleethorpe-with-Thrunscoe Urban Sanitary District.

Weekly Periods, 1893.	No. of Deaths from Disease of the Nature of Cholera.	No. of Diarrhœa Deaths.	No. of Deaths from Enteric Fever
Week ending August 5th	—	—	—
,, ,, 12th	—	—	1
,, ,, 19th	1	3	—
,, ,, 26th	—	3	—
,, September 2nd	5	1	—
,, ,, 9th	1	3	—
,, ,, 16th	—	—	1
,, ,, 23rd	—	2	—
,, ,, 30th	—	—	—
,, October 7th	—	—	—
,, ,, 14th	—	1	1
,, ,, 21st	—	—	—
,, ,, 28th	—	—	—
,, November 4th	—	—	—
,, ,, 11th	—	—	—
,, ,, 18th	—	—	—
,, ,, 25th	—	—	1
,, December 2nd	—	—	—
,, ,, 9th	—	—	—
,, ,, 16th	—	—	1
,, ,, 23rd	—	—	—
,, ,, 30th	—	—	—
,, ,, 31st	—	—	—
Totals -	7	13	5

The facts, so far as they go, show that fatal diarrhœa in Cleethorpes did not, as in Grimsby, precede prevalence of cholera. Both diseases commenced to be fatal in one and the same week, namely, that ending 19th of August; and the fact is not a little suggestive of the choleraic nature of the fatal diarrhœa occurring at this time in Cleethorpes. For the rest, fatal diarrhœa outlasted the disease registered in the local death records as cholera, and such fatal enteric fever as occurred in Cleethorpes manifested itself later in the main than did either cholera or diarrhœa.

V.—DISTRIBUTION IN *AREA* OF DISEASE OF THE NATURE OF CHOLERA, OF DIARRHŒA, AND OF ENTERIC FEVER.

App. A. No. 2. On Cholera in Great Grimsby and Cleethorpes in 1893; by Dr. Reece.

Grimsby.

Contrast of the extent to which various parts of Grimsby were invaded by disease of the nature of cholera, by diarrhœa, and by enteric fever respectively is obtained by noting the number of known attacks of choleraic disease during the period August 11th to October 14th, of diarrhœa during the period September 1st to September 13th, and of enteric fever during the entire year, in each of the several wards of the borough.

Table VII.

Showing for each Ward and for the whole Borough of Grimsby the Number of Persons ascertained to have been attacked by Disease of the Nature of Cholera, and by Diarrhœa in certain Weeks of 1893, as well as the Number of Enteric Fever Cases notified during the entire Year; together with the Attack Rate from these causes per 1,000 population in each instance.

District.	Acreage.	Population.		Cholera and Choleraic Diarrhœa, Aug. 11 to Oct. 14.		Diarrhœa Sept. 1 to Sept. 13.		Enteric Fever during the whole Year.	
		Census of 1891.	As estimated by the Sanitary Authority in 1893.	No. of Attacks.	Attack Rate per 1,000 Population.	No. of Attacks.	Attack Rate per 1,000 Population.	No. of Attacks.	Attack Rate per 1,000 Population.
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Humber - -	78	12,584	13,107	43	3·28	128	9·77	129	9·84
N.E. - -	107	10,544	9,991	24	2·40	107	10·70	31	3·3
N.W. - -	692	6,130	6,222	27*	4·33	58	9·32	32	5·14
S. - - -	1,028	5,699	5,699	3	·52	49	8·59	26	4·56
S.W. - - -	254	10,305	10,291	21	2·04	72	7·00	82	7·9
Wellow-Weelsby -	959	16,672	8,690	9	1·03	62	3·72	26	2·99
Borough of Grimsby	3,120	51,934	54,000	127	2·35	476	8·81	326	6·04

* Two cases included in this number occurred on the shipping in the Alexandra Dock, which is situated in this ward.

From this table it will be seen that as regards disease of the nature of cholera, the attack rate for the borough, from August 11th to October 14th, was 2·35 per 1,000 people living, and that this rate was exceeded in the Humber Ward (3·28) North-East Ward (2·4), and North-West Ward (4·33).

The diarrhœa attack rate for the borough, from September 1st to September 13th, was 8·81 per 1,000 people living; a rate which was exceeded in the Humber Ward (9·77), North-East Ward (10·70), and in the North-West Ward (9·32).

The enteric fever attack rate for the borough was 6·04 per 1,000 people per annum; a rate which was exceeded in the Humber Ward (9·84), and South-West Ward (7·96).

The fact that the Humber Ward, which, as is seen from the table, is the most densely populated of all the Grimsby wards, suffered exceptionally from all three of the diseases under investigation, raised the question as to how far crowding of population on area had been related to differences of prevalence of one and another malady. Accordingly the following subsidiary table was constructed for the purpose of ascertaining what were the ratios of the figures representing density of population, and amount of disease of the nature of cholera, of diarrhœa, and of enteric fever for each of the wards to the corresponding figures for the borough as a whole.

SUBSIDIARY TABLE showing, for each of the Wards of GRIMSBY, Density of Population, and CHOLERA, DIARRHŒA, and ENTERIC FEVER Death-rates in their relation to similar Data for the Borough as a whole; the latter Data being represented in each instance as a constant 100.

Area.	Density of Population.	Attack Rate.		
		Cholera.	Diarrhœa.	Enteric Fever.
Whole borough - -	100	100	100	100
Humber Ward - -	970	140	111	163
N.E. „ - -	590	102	121	55
N.W. „ - -	53	184	106	85
S. „ - -	30	22	97	75
S.W. „ - -	244	87	79	132
Wellow „ - -	104	44	42	49

This table fails to afford indication of direct relation between recorded density of population and incidence of cholera, diarrhœa, and enteric fever. Thus the North-West Ward, with a less dense population than almost any ward, had relatively even more disease of the nature of cholera than the Humber Ward with the densest population of all: and this notwithstanding that the latter ward suffered more enteric fever than any other. On the other hand the North-East Ward, which is second only to the Humber Ward in density of population, had less enteric fever than almost any ward, though it suffered more than its share of diarrhœa and of cholera. The maps annexed to this report, indeed, suffice to show that the figures of Table VII. with respect to density of population are of little worth. These maps indicate that the Grimsby Wards are not equally built over; that for instance the North-West Ward with few persons per total average is nevertheless in part densely built on, and that this closely built section of the particular ward suffered in some respects far more, in others fully as much, as any part of Grimsby, from the maladies which are in question.

CLEETHORPE-WITH-THRUNSCOE.

As has been already said the data for Cleethorpes are limited in the main to the deaths referred to the maladies under investigation. These deaths were too few in number for any inferences to be drawn from them as to localisation of one or another disease in the village. The deaths in question, as plotted on the map of the Grimsby and Cleethorpes districts which is appended to this report, appear to have been indifferently distributed throughout the place.

VI.—SOURCE OF THE CHOLERA.

Grimsby.

I have previously mentioned that the S.S. "Dania," which arrived off Grimsby on August 2nd, had on board an engineer sick with cholera. This patient died the following night on board the Port hospital ship, the corpse being landed on August 4th and forthwith buried.

The *first* death on shore, from what was in all probability true cholera, occurred at 59, Trinity Street, Humber Ward, the patient being a man named F——, aged 49. He had been out of regular employment for the six months previously, and had obtained work at odd times at the docks, usually in assisting to unload timber ships. The week before his death the weather had been hot and he had been working hard. The night before his illness he ate a supper of cockles, and was attacked in the early morning of the following day, August 10th, with vomiting and diarrhœa and died 40 hours after seizure. His wife had been "ill" for some weeks previously, and on the death of her husband she removed to another portion of the town, where she died two days later, her death being attributed to "syncope." On inquiry it was found that there was no suspicion of cholera in the case of the wife. Although minute investigations were made as to this man's antecedents and movements prior to his death, nothing beyond that stated above could be found bearing on the case. The death of both man and wife, with the lapse of time since their deaths occurred, made the inquiry a difficult one.

The *second* fatal case of similar sort was that of the woman who died August 15th at 28, Harrington Street, after an illness of eight hours. This case was probably true cholera. Harrington Street is, it will be remembered, in that portion of the Cleethorpe-with-Thrunscoe Urban Sanitary District which adjoins the New Clee part of Grimsby. It faces and runs parallel with the river. This woman had, like the man above referred to, partaken of cockles for supper on the night before her death. This is the Cleethorpes case which has been referred to as etiologically belonging to Grimsby.

The *third* fatal case was G. R., aged 16, of 92, Park Street, Humber Ward, a boundary street between the Great Grimsby and the Cleethorpe-with-Thrunscoe Urban Sanitary Districts. He came home from his work at the Ice House near the docks on August 18th, about 10 p.m., feeling ill. About midnight he was taken with diarrhœa and cramps; he became collapsed, and died at noon on August 19th. His death was registered as due to diarrhœa; but the clinical symptoms, and the rapid course of his illness to a fatal conclusion, seem to point to cholera as the cause of death.

The *fourth* fatal case, W. P., aged 13, of 106, Grafton Street, Humber Ward, was taken with choleraic symptoms, and died on August 20th, before medical assistance arrived. He died within 12 hours of his seizure. This death is, like that of G. R., certified as due to "diarrhœa"; but it was no doubt true cholera. The family have removed from Grimsby, and no details could be obtained.

Fifth fatal case.—On August 20th, the death from "English Cholera" occurred of a man named H———n at the back of 44, Trinity Street, Humber Ward. This man was a master block-maker

and had been employed at the Fish Docks. His death took place after an illness of 24 hours, during which time he received medical attendance at the hands of Mr. C. Byron Turner. This gentleman had, at the date of my visit to Grimsby, no hesitation in saying that the death had been due to true cholera.

Sixth fatal case.—Also on August 20th, a woman named H—t, aged 23, who resided at 136, Rutland Street, Humber Ward, died of what was probably true cholera after 28 hours' illness.

After August 20th cholera cases began more rapidly to increase in number, and by the second week of September had affected all the wards of the town.

Although minute inquiry was made into all the other ascertained cases (9) occurring prior to August 30th, no definite information tending to throw light on the source of the cholera was discovered. There were, however, some conditions in common as regards certain cases. Several had partaken of cockles shortly before attack, and others were employed in or about the docks. Moreover, the earlier deaths were, as has been indicated, limited to the Humber Ward in and around Trinity Square, inclusive of Harrington Street, in the Cleethorpe-with-Thrunscoe Urban Sanitary District. This locality, as will be seen from the map, is close to the docks, sea shore, outfall of the sewer, and the cockle beds. With exception however of this condition of locality, nothing was shared in common by the earliest known cases. I next sought to ascertain whether persons other than those above enumerated had not been attacked by sickness bearing a suspicious resemblance to cholera, at such time and in such circumstances as to constitute connecting links between the fatal cases I have enumerated and between these and antecedent cholera. But I could not discover any such cases. This negative result of inquiry with a view of definitely ascertaining how cholera was introduced into Grimsby is to be regretted, but, as in the case of Hull, is not altogether matter for surprise. Cholera, be it remembered, was in 1892 severely epidemic in Hamburg, with which town, as with other continental towns which were also attacked, Grimsby is in daily communication. In that year (1892) three persons suffering from choleraic diarrhœa and one suffering from diarrhœa of a suspicious character are known to have arrived at Grimsby from Hamburg. All four were removed to the hospital ship "Bradford," where three recovered and one died, the corpse being buried with due precautions in the borough cemetery. The ships which brought these people were disinfected, and infected articles as far as possible destroyed. The two first cases developed on board the S.S. "Talavera" on August 28th, the vessel having arrived from Hamburg on 24th, and being in dock at the time the patients were seized with the disease.

So, too, in 1893 cholera is known to have been recrudescent on the Continent antecedent to its appearance in Grimsby; and a case was brought there from Antwerp in early August. Thus, on August 2nd, the S.S. "Dania" arrived from Antwerp, the engineer of which vessel died and was buried as previously stated. But I could obtain no evidence whatever that subsequent cases of cholera in Grimsby had been related directly or indirectly to infection brought by the "Dania." Locally, indeed, it was considered more probable that cholera had been introduced in one or other of the following ways:—

S.S. "Huddersfield."—It was thought at Grimsby that the disease might have been introduced into the place by the S.S. "Huddersfield," belonging to the Manchester, Sheffield, and Lincolnshire Railway

Company, which trades regularly between Grimsby and Antwerp, sailing from Grimsby on Saturdays, and returning on Thursdays. I allude to this case at length, for the reason that locally much importance is attached to it, a great deal of which would appear to vanish when the facts are known.

This steamer arrived at Grimsby from Antwerp on August 3rd, 1893, and left at 10 minutes after midnight of August 5th and reached Antwerp at 10.45 p.m. on Sunday, August 6th. The stewardess was attacked about mid-day on August 6th with vomiting and diarrhœa, about 12 hours after leaving Grimsby, and 10¾ hours before arrival at Antwerp. On arrival at Antwerp the captain sent for a medical man, who attended the stewardess on board the vessel. When the ship was leaving Antwerp on August 9th, this doctor wrote a certificate to the following effect:—

"Cette personne est atteinte d'un embarras gastro-intestinal ne presentant aucun caractère contagieux."

The stewardess was also seen by Dr. Simpson, the acting Port Medical Officer of Health, on her return to Grimsby on August 10th, and was not considered by him to be suffering from cholera. At any rate, if the case were one of true cholera, the disease was apparently contracted in this country.

The stewardess lives in Cleethorpes, where her father keeps restaurant-rooms, his customers being chiefly "trippers." Both he and his wife had diarrhœa, and pains in the limbs and vomiting about the time that their daughter was ill. However, they thought little of their symptoms, and had no medical advice.

Further inquiry showed that the stewardess occasionally sent some of her personal linen to be washed at the Grimsby steam laundry. She is positive in her statements that she sent none of her linen to the laundry on her return from Antwerp on August 10th. An entry in the books of the laundry shows, however, that some linen was received from her during the week ending August 12th. This laundry is a large one, and washes for a large number of families in Grimsby; from a sample of the body linen, &c., sent in to be washed it was evident to me that the customers are not confined to the upper classes. The washing of all sheets, pillow-cases, blankets, towels, &c., of the vessels, among them the S.S. "Huddersfield," belonging to the Manchester, Sheffield, and Lincolnshire Railway, is carried on at the laundry. The private effects of some of the crews are also washed at this laundry. Inquiry at the laundry during the early part of September showed that none of their servants had died this year, or had been invalided for sickness.

As to shellfish, in regard of which locally some suspicion attached, it deserves notice that the main sewer is tide locked, and discharges into a culvert or groove in the sand. As the tide rises it causes the sewage to collect in the main sewers, to flow out again as the tide ebbs. Near by this sewer outfall are the cockle beds from which Grimsby people dig their cockles. This place is also the favourite bathing place of the youth of Grimsby.

[Although oysters were not locally suggested as being concerned with the cholera, it should be here stated that there is a large oyster trade with Grimsby, under circumstances that will be referred to later on.]

Importation of Second-hand Furniture.—Enquiries were made in respect to the importation into Grimsby of secondhand furniture from Hamburg. There are only two firms in Grimsby who engage in this trade, and they import articles chiefly consisting of office furniture. The better class of chairs, sofas, carpets, and bedsteads are also brought over. There is a considerable trade of secondhand furniture passing through Grimsby to auction rooms at Sheffield, Manchester, Leeds, and Bradford. As far as could be ascertained the families of the first persons attacked by cholera in Grimsby had not bought any

furniture for a year previous to the outbreak, nor indeed, were they the class of person who could afford to buy such furniture as is here in question.

Trade in Rags.—The rag trade to Grimsby is principally from French ports, notably Dieppe. Hamburg, Antwerp, and Rotterdam, however, also contribute. The rags are packed in bales, and sample bales are opened by the railway company's men as required by the Custom House officers. Therefore all bales are not necessarily opened, a tuck stick being passed through each bale. There were, in September 1893, a few hundred bales lying in the warehouses by the docks at Grimsby. Enquiries tend to show that no officer of H.M. Customs or railway employé was attacked by the prevailing epidemic in Grimsby, nor that anyone employed in the manufactories, to which the rags are transmitted, in Dewsbury or Batley suffered from cholera. The number of bales of rags passing into Grimsby between August 9th—September 1st, 1893, was 4,320 bales.

Immigrant and Transmigrant Traffic.—There is a large immigrant and transmigrant traffic through Grimsby; many of these people came from districts infected with cholera, and had shipped from Esbjerg, Maltho, Gothenburg, Antwerp, Hamburg, and Rotterdam, for Grimsby. The majority does not remain in the country, being booked through for America viâ Liverpool, and a few to South Africa. It is presumed that the remainder stop in England. An idea of the number is furnished by the following figures.

A List of the Number of Immigrants who arrived from Esbjerg, Maltho, Gothenburg, Antwerp, Hamburg, and Rotterdam, at the Customs Port of Grimsby in the first eight Months of 1893—

	Total.	Transmigrants.	Number presumably remaining in England
January	593	408	185
February	1,367	1,012	355
March	2,620	1,607	1,013
April	4,304	4,027	277
May	3,871	3,535	336
June	2,784	2,601	183
July	1,516	1,348	168
August	1,715	1,612	103
Total	18,770	16,150	2,620

The immigrants on arrival are for the most part taken to sheds in the docks, there to await the train which takes them away. They leave Grimsby principally by the Dock Station, which is a little distance outside the docks. Occasionally they wander into the town in search of provisions, &c. There was in 1893 no suspicion of illness among any of these people in Grimsby or after they left it.

From a study of the above-mentioned statements it will be seen that the source of the choleraic disease which occurred in Grimsby in 1893 remains far from clear. It may perhaps be inferred that some persons or person, suffering from cholera not recognised as such, had either in 1892 or 1893 arrived in Grimsby, thus conveying the infection to the district; and in that connexion the facts respecting the S.S. "Pere-

grine," which arrived in Harwich from Hamburg in 1892, are of interest. This vessel landed her passengers apparently in good health, yet two of them were attacked by cholera on their arrival in London.

In some such way, either in 1892 or 1893, the infection of cholera may have been introduced into Grimsby.

Cleethorpe-with-Thrunscoe.

From the foregoing facts it must needs be doubtful whether the disease was in 1893 introduced into this place from Grimsby, or whether the infection of the disease had been deposited in the district in 1892.

As has been pointed out, a portion of the district is a direct extension of the town of Grimsby; moreover, the village of Cleethorpes is in daily communication with Grimsby. Many people, too, whose daily work lies in Grimsby have their habitation in the Cleethorpe-with-Thrunscoe district; thus several of the servants of the Manchester, Sheffield, and Lincolnshire Railway employed in the docks, on the railway, or line of continental steamboats, reside in the Cleethorpes district. With reference to the fact that several people in inland towns were attacked with choleraic disease not long after eating oysters at or from Cleethorpes, the description in the addendum to this report on the oyster trade of Grimsby and Cleethorpes will prove of interest.

VII.—MAINTENANCE OF CHOLERA.

Grimsby.

Propagation through Personal Relation with Antecedent Cholera.—In one or two cases personal communication was found to have existed between persons attacked. For instance, between a man W. and his daughter, and a woman P. who nursed them;* all three of whom died. In another instance a father apparently contracted the disease from his son, and died in a few hours—the son recovered. So, too, a woman, H. M., who died on September 1st, had nursed a patient, who died of cholera on September 2nd†. But in the majority of cases communication could not be traced between persons attacked and previously invaded households. It therefore became necessary to consider means by which cholera could have been maintained in Grimsby subsequent to the time at which it is known to have first appeared there; and, as a result, in the absence of any satisfactory explanation of the facts of the cholera, the sanitary circumstances of the borough in many aspects came under review. In this connexion special attention was of course given to the Humber Ward wherein cholera became earliest established.

The conditions involved in the general sanitary circumstances of Grimsby; its sewerage and drainage arrangements, disposal of excreta and refuse, and the water-supply, are as follows:—

General Sanitary Circumstances.—The topography and geology of Grimsby have already been briefly referred to. The subsoil water stands at a level of 18 inches below the surface; thus

* Table I. A., Nos. 6, 12, and 14.
† „ Nos. 16, 19.

houses with cellars or basements are liable to be very damp. Roadways are generally well paved and scavenged; house yards, court yards, alleys, and passages are for the most part well paved with stone flags, brick, cement, or asphalte, and kept in clean condition. The dwellings of the poorer classes are usually two-storey brick cottages, occupied in each instance by one family only, although there are exceptions. The condition of these dwellings on the whole is fair, although exceptions to the rule are not wanting. The condition of the town compares favourably with certain midland towns, or the old towns of Wales.

Sewerage and Drainage.—Spread of cholera in Grimsby has been referred by certain persons to the system of sewerage. And it must be confessed that the sewerage system as it existed in the summer of 1893 was open to many improvements. The Sanitary Authority are, however, endeavouring to effect alterations, which it is hoped will place the draining and sewering of the town on a better footing. What measure of success their attempts will achieve remains to be seen. The main sewers running under the principal streets are circular, built of brick; the largest are 7 feet 6 inches in diameter. The average fall is 1 in 1,600; the minimum, 1 in 1,800, and the maximum, 1 in 1,200. The tributary sewers are made of glazed earthenware pipes, 12 and 9 inches in diameter, and the fall in nearly every instance is insufficient. Owing to the want of fall these sewers cannot be self-cleansing. There are two outfalls to the sewers, one at Pyewipe, and the other into a channel in the sand outside the Fish Dock. The former receives the drainage from the south and south-west wards of the town, and the drainage from the "Heycroft drain," an open sewer, into which many drains enter. The Fish Dock outfall receives, in addition to the town drainage, a small rivulet called the East March Drain, which brings in the drainage from a considerable agricultural district. The sewer outfalls are guarded by "sling gates," which are supposed to open during the ebb and shut during the flow of the tide. During a great portion of each 24 hours the sewage remains ponded in the sewers. The system of sewerage receives the storm water, which at times would help to swell the volume of sewerage pent up in the sewers. In fact, it has been stated that the main sewer is sometimes absolutely full from the outfall half-way up the town.

Only the kitchen or slop-water passes into the sewers in the greater portion of the district. As a rule house drains commence in the back yards and not inside or under the houses. These drains join the tributary sewer at the bottom of the yard, and the tributary sewer joins the sewer of the road which runs at right angles to it. House drains are not disconnected from the sewers.

The sewers are ventilated by man holes in the centre of the streets, placed at intervals of one to two hundred yards. There are no supplementary ventilating shafts provided, and, as many of the manholes have been closed on account of the smell arising from them, the sewers are insufficiently ventilated.

Only about 3 per cent. of the road storm-water gullies are properly trapped from the sewers. The rain-water pipes in Grimsby generally run directly into the house or yard drain with no intervening trap or gully. Thus they act as ventilators for the sewers. The joints of these rain spouts are often loose, and allow sewer air to escape near the level of the windows. When there are sinks inside the dwellings, the sink pipes empty, as a rule, over gullies outside the houses.

To all these defects is added the disadvantage of the *Grimsby cesspool*. These so-called "cesspools," which, to the number of about 8,000, are to be found in Grimsby, are not cesspools in the ordinary acceptance of the term, but rather "catch-pits" on the line of the house drain. They are, in fact, receivers placed on the course of the drain, to catch any solid matter and to prevent it passing to the sewers, which, owing to their want of fall, might readily become silted up if much solid matter found its way into them. According to a recent report of the "Cesspools Committee of the Town Council," some 4,500 of the "cesspools" are built of brick, and have a capacity of from 10 to 60 gallons, and some 3,500 are "Sharp's Gullies, No. 3," or sanitary pipes placed on their ends. In the old town alongside the railway, in the neighbourhood of Freeman and Hainton Streets, as also in the Humber Ward, cesspools are especially numerous.

These cesspools or catch-pits are as a rule found in the yards of the houses, and they are fitted above with an iron top trap. This often fits imperfectly, and the sewer air can escape into the yard, frequently in proximity to the back windows and doors. Moreover, the joints of the bricks forming the cesspools are often loose, and allow the fluid contents to escape into the soil around and sometimes into the foundations of the house. Owing to sewage being backed up in the sewers for a large part of the 24 hours, sewer air, and sometimes even the sewage, is driven out of these "cesspools."

In some instances, as I ascertained, choleraic stools had been emptied into these cesspools, and it is extremely probable that in many instances bowel discharges, unrecognised as being infective, although quite possibly of an infective character, were passed into the sewers without previous disinfection. In this way cholera may have been helped to establish itself in Grimsby.

It is true that in instances where emptying of choleraic evacuations into "cesspools" came to the knowledge of the Sanitary Authority, the cesspools were opened, cleaned out, and disinfected, and the drain flushed by water from a hose. Special attention was given to this in the Humber Ward as soon as it was ascertained that cholera was becoming established in that neighbourhood. But it must not be forgotten that in many instances these cesspools are in a leaky condition, that they communicate with the sewers, and that the infective material may have leaked into the soil or have found its way into the sewer before the disinfectant and flushing measures were applied. In such cases imperfect means of ventilation, deficient fall, and absence of systematic flushing of sewers would then help to foster within them the cholera microbe. So far as could be ascertained, however, the cholera in Grimsby did not affect any particular line of sewers.

Excrement and Refuse disposal.—It is only in the better class of house that there are water-closets inside the dwelling. Practically there are but few water-closets in Grimsby. In by far the greatest portion of the town "the closet" is placed outside the houses. Boxes or pails are placed under the closet seats, and are removed once a week by a contractor, who disposes of their contents in agricultural districts for manure, or conveys the excreta to the depôt beyond the West Marsh.

The "boxes" are wooden receptacles; when new they are tarred halfway up the inside, and they are of various sizes. A common size is 30 inches long by 18 inches wide, and 16 inches deep, though there are many larger. The boxes, besides receiving the human excrement, solid and liquid, are also used as receptacles for household refuse. There are only a few houses in the district where separate receptacles

are provided for refuse, namely, the houses furnished with water-closets. In the privy wall there is an aperture (not always kept closed) through which the box is drawn out by the night-soil men, and generally matters are so arranged that the box is removed through a separate entrance without passing through the house. There are only 30 houses where this latter procedure is necessary. In many instances there is another aperture high up in the privy wall made by leaving out a brick or two. This aperture is for ventilation, the result being that the wind creates a draught and occasionally blows the lighter contents of the boxes about. As in many cases the privies are close to the kitchen windows, this becomes a matter of importance.

The night-soil men work between 10 p.m. and 8 a.m. On their round they draw out the "box" and empty its contents into a scuttle, and the scuttle is carried to the night-soil cart into which its contents are emptied. Thus, when the "box" is emptied into the scuttle and again when the scuttle is emptied into the cart, a certain amount of débris may be set free to contaminate the atmosphere. The contents of these boxes is not always dry. It frequently happens that the boxes are full to overflowing with semi-fluid matters, and the night-soil man, notwithstanding that there are fines and penalties against the contractor for "slopping," naturally spills some of the contents of the box in attempting to empty the contents into the scuttle. Again the boxes very often leak, and allow the fluid contents to ooze out to the space beneath the closet seat. Also the boxes naturally become sodden with organic filth, and a sticky mass tends to collect at the bottom and sides, which are seldom thoroughly cleaned; added to which the night-soil men are under the additional disadvantage of working largely under cover of darkness.

Whenever these boxes were known or suspected to be infected with choleraic discharges, the Sanitary Authority caused them to be burnt and replaced by galvanised iron pails. Nevertheless, it must be evident that in many cases bowel evacuations, which were not considered choleraic in character, but which may have been none the less "infective," were passed into the boxes, many of which remained in use; and that possibly contamination in this way of the premises of houses and of the atmosphere may have helped to disseminate cholera.

Milk Supply.—No information was obtained which tended to place any particular supply of milk under suspicion, or of its having acted in any way in the transmission of the disease.

Water Supply.—The supply of Grimsby is derived from two sources—from the Great Grimsby Waterworks Company, and from private wells sunk in the town.

The Great Grimsby Waterworks Company supply water for domestic purposes to the greater portion of the Urban Sanitary District.

The water is obtained from about 14 artesian wells sunk in the chalk; four of them at Little Coates, and the other ten at Beconthorpe Cleethorpes. The Little Coates wells are 21, the others 6 inches diameter. Both sets of wells are constructed of iron cylinders, covered in with brickwork and cement, having bore holes varying in depth between 80–100 feet.

The water is pumped directly into the mains, there being no reservoir. The supply is constant and is not turned off, except for such purposes as necessary repairs to the mains. The mains are coated with

Dr. Angus Smith's preparation. The following is a copy of an analysis of the water made four years ago by Mr. Baynes, borough analyst:—

"Sample of water taken from Grimsby Water Company's works on July 19th, 1889:—

	Grains per gallon.
Carbonate of lime	14·41
Sulphate „	1·71
„ magnesia	·83
Chloride of sodium	1·97
Nitrate of lime	·98
Alkalies	·10
Total solid residue	20·00

	Parts per million.
Free ammonia	·016
Albuminoid ammonia	·028

	Degrees.
Temporary hardness	13·95
Permanent „	2·80
Total	16·75

The above represents a high degree of purity.

(Signed) James Baynes."

From this analysis it will be seen that chemically the water was in 1889 good water, but as is usual in waters derived from the Chalk, a trifle hard. It falls on the Lincolnshire wolds, and is tapped by the wells at some considerable distance from the town. Hence it should be exceptionally free from risk of pollution; and it was in no case under suspicion.

But as has been implied, some houses do not have the company's water, but are supplied by wells on their own premises.

Of these private wells, there are 162 in the borough, and they supply some 1,166 houses out of a total of 10,631 inhabited houses.

All these wells are carried through the Boulder Clay to the Chalk, and range from 80 to 140 feet in depth. I am informed by the Sanitary Authority there are no such things as surface wells in the district. The Grimsby well is usually of the following construction; the well is lined to a depth of about 7 feet with glazed earthenware tubes 18 inches in diameter, with cemented socket joints; the lowermost tube rests on a flagstone, from a hole in the centre of which a bore hole lined with an iron tube is carried down to tap the springs in the chalk. Such a well properly made yields good water, but it sometimes happens that, through defective workmanship or shifting of the ground, the joints crack, allowing soil water polluted from leaking "cesspools" possibly to enter and contaminate the well. I saw samples of the various "pump" waters at the Town Hall which had been collected by the Inspector of Nuisances, and several of these were discoloured and had deposited sediment. No record of chemical analysis of any of these well waters was available. A map showing the position of these wells is annexed.

As far as could be ascertained at the time, the attacks of choleraic illness occurred independently of any source of water supply. The

earlier cases of the outbreak occurred in dwellings served with the company's water, and although it was impossible to eliminate the chance that these persons partook sometimes of well water, still the water ordinarily consumed by them would undoubtedly be derived from the water delivered to the taps near their dwellings; and although at a later period persons were attacked who drank well water, yet no particular well was ever brought under suspicion. Of the 127 cases of disease of the nature of cholera occurring in Grimsby, 13 drank well water, and of these two died.

Cleethorpe-with-Thrunscoe.

Here personal communication, direct or indirect, appears to have played but a small part in the propagation of the disease; moreover, no adequate explanation could be found for its maintenance after it first made its appearance in the district.

General Sanitary circumstances.—The district of the Cleethorpe-with-Thrunscoe Urban Sanitary Authority covers an area of 1,196 acres. The geology of the district has been already alluded to.

Sewerage and Drainage.—All the occupied roads appear to be sewered in Cleethorpe-with-Thrunscoe; the place being provided with two separate sewer systems. The *southern half* of the village was sewered in 1870. The sewage, after passing through two brick settling tanks (15 feet by 7 feet 6 inches), is discharged without further treatment into the Humberstone Beck at a point where it is tidal.* This Beck, which is crossed by a footpath, was in May 1893 in a very foul condition, although it had been cleaned out two months previously. The sewers of this system are circular glazed "sanitary" socketted pipes with clay joints. The main sewer is 18 inches in diameter and the branches 12 inches and 9 inches. This sewer has near its outlet a fall of only 1 in 1,540; but most of the branches have a gradient of 1 in about 400. The sewers are deficiently ventilated, being provided only by a few open gratings at the dead ends. To some extent they are ventilated up the down spouts of the houses. There is no provision for permanent flushing apparatus on this system. It is flushed with water from the company's mains three times a year.

The *northern half* of the village was sewered in 1888 to an outfall in the sea below the low-water mark at the north end of the district. This is known as the Beaconthorpe outfall. These sewers are circular stoneware socketted pipes, of 18 inches, 21 inches, 24 inches, and 30 inches diameter; branch sewers are 12 inches and 9 inches. The gradients are 1 in 1,187 to 1 in 1,215 for the main sewers, and 1 in 400 to 500 for the branches. The sewers are ventilated by open gratings every 100 yards. There is one flushing tank at the head of the system.

House Drainage.—Where closets are in use the closet drains go direct into the sewers without any disconnexion or fresh air inlet. There are "cesspools" on the drains as at Grimsby. The water-closet soil pipes were found to be 4-inch iron pipes, ventilated only by 2-inch pipes

* The neap tides do not get up the Beck to the point in question.

When the Board's Inspector, Mr. T. W. Thompson, inspected the district at the end of the spring of 1893, he found many of the soil pipe joints defective. On discharging water down the closet of a house in Balmoral Terrace it oozed through a defective joint in the soil pipes close to a window. As these soil pipes communicate directly with the drains and sewers they obviously ventilate the sewers close to the windows of the dwellings. The waste pipes from sinks in houses seem to discharge mostly over gullies outside the house walls. The majority of the houses, however, have no sinks inside them. In such cases there are sinks in the yards. Some of these have large 9-inch stoneware gullies usually surmounted with "bell" or "lip" traps, but not a few of them have square brick catchpits (18 inches square) and trapped only by bell or lip traps, which in some instances were broken.

Disposal and Removal of Excreta and Refuse.—With the exception of some houses which have water-closets, almost all the houses are provided with privies having moveable receptacles. These receptacles consist of wooden boxes varying from 2 to 3 feet in length, and about 18 inches in breadth. In a few instances, however, privies with fixed receptacles were found. Sometimes these fixed receptacles were of considerable depth. Some houses are provided with ash-pits, but most of them use the privies for refuse disposal, hence the large size of the wooden boxes. Ashpits are generally uncovered, and often of defective character. The Sanitary Authority contract for the removal of excrement and refuse and the cleaning of "cesspools" The existing contract is for three years, two of which have elapsed. It requires the removal of excrement and house refuse once in seven days for 10 months in the year, and bi-weekly in July and August. The "cesspools" are to be cleaned once every month. The scavenging seems to be done satisfactorily except in a few isolated instances. The contractor takes the excrement and refuse to a depôt provided by the Urban Sanitary Authority in a field off the Humberstone Road. The depôt comprises half an acre of land, and is situated about 150 yards from the road, 500 yards from the village, and 200 yards from a farmhouse.

Water Supply.—The Great Grimsby Water Works Company's mains are laid in the district. The majority of the houses in the Cleethorpe-with-Thrunscoe Urban Sanitary District are now supplied with this water, which is laid on to the larger houses, and to stand pipes in the yards of the smaller houses.

There are about ten private wells still in the district. The wells are in some cases sunk in proximity to old drains, and some of the wells are dry steined.

VIII.—SANITARY ADMINISTRATION.

Grimsby.

The sanitary administration of the Urban Sanitary District of Great Grimsby is vested in the Corporation as the Urban Sanitary Authority. The powers of the Corporation are delegated to a Sanitary Committee, of which Mr. Alderman Jacob Marshall is Chairman. The administration is carried out by the Medical Officer of Health, who is in private practice, along with an Inspector of Nuisances and an Assistant Inspector of Nuisances.

The Inspector of Nuisances is responsible to the Sanitary Committee, but acts under the Medical Officer of Health in matters connected with

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infectious disease. The Assistant Inspector of Nuisances is also responsible to the Sanitary Committee, acting, so far as his own district is concerned, independently of his colleague, but he acts under his senior's orders when required to do so. The drain flushers, distributors of disinfectants, whitewashers, &c., are borrowed as required from the Highways Department, no regular staff being employed for these purposes.

The Sanitary Authority disinfect free of charge houses that have been invaded by infectious disease, and also articles that have been exposed to infection.

Cholera Arrangements in 1892.

On the outbreak of cholera at Hamburg in August 1892, the Sanitary Authority adopted, at instance of Local Government Board, special measures of prevention against this disease.

They carried on a system of medical inspection of passengers and crews of vessels coming foreign, and for this purpose kept their hospital ship "Bradford" moored outside Grimsby Harbour, and the steam-tug "Chapman" in attendance to carry their Deputy Port Medical Officer of Health, Dr Simpson, to and from the shipping. Dr Simpson lived on board the hospital ship, and was thus able to meet the incoming vessels at each tide. A Custom House officer also dwelt on board the "Bradford" and visited the vessels with the Deputy Port Medical Officer of Health. This inspection of shipping was continued until December 1892, when the hospital ship was towed into dock.

On shore the Sanitary Authority divided the town into districts for special scavenging purposes, and caused placards to be posted and notices to be left at every house recommending that in all cases of diarrhœa medical attendance should at once be sought. These notices treated briefly of precautions against cholera in matters of food and drink, and stated that the Sanitary Authority had made arrangements with the medical men of the town to give advice to, and prescribe for, any person applying to them, attacked with diarrhœa, and had authorised druggists to supply disinfectants at the cost of the Sanitary Authority. The Sanitary Authority also arranged for a supply of hospital tents from London, and for the speedy interment in quicklime of the corpses of persons dying of cholera. One or two bodies were actually thus interred, although there was no evidence forthcoming as to the illness causing death having been in any way due to cholera.

During the winter, 1892–93, Mr. Alderman J. K. Marshall, the Chairman of the Sanitary Committee, made endeavours to have a hospital for isolation of infectious diseases built, the hospital which had been used in the small-pox epidemic being considered unsuitable for the treatment of infectious diseases. But the town council did not support the Sanitary Committee in this matter, thinking probably, that as the district had escaped cholera in 1892, it would escape also in 1893, and preferred to consider plans of improving the appearance of the town, as, for instance, by the construction of boulevards, and like works.

Cholera Arrangements in 1893.

During the spring and early summer of 1893 Mr. Alderman J. K. Marshall advocated the adoption of similar means to those employed in 1892. Again, however, the Sanitary Authority did not, as a whole, give its support to Mr. Marshall. On shore the hospital remained unbuilt, the hospital ship remained in dock, and medical inspection of the passengers and crews of ships arriving in Grimsby from places on the Continent, where cholera was occurring, was not resumed.

Thus matters stood until the S.S. "Dania" arrived at Grimsby with a case suspiciously like cholera on board. The hospital ship "Bradford" was then, on the following day, towed out of dock and moored off Grimsby, having been equipped with a crew and having Dr. Simpson on board. The sick man was removed to her and died on board. Medical inspection of incoming foreign vessels was commenced the following day, August 4th, in the same way in which it had been carried out in 1892.

On occurrence of a death on shore, attributed to "cholera nostras" on August 11th, notices and placards, similar to those issued in 1892, were left at the houses and posted in conspicuous places, and on August 25th the Sanitary Authority of Grimsby applied, by circular note, to the medical men of the place requesting them to report cases of choleraic character. As this notice did not produce the desired effect, on August 31st the Sanitary Authority sent round a second circular stating that "the usual fee of 2*s.* 6*d.* will be paid for each notification," and that a fee of 5*s.* per case would be paid to the medical men on giving advice and a prescription to persons applying to them attacked by diarrhœa, and on September 1st the notification and fee was extended to "diarrhœa."*

It is manifest that the Sanitary Authority regarded the outbreak from the very first as of grave import. The sick were isolated as far as practicable without removing them to hospital, their premises were disinfected, and the dead were speedily buried in quicklime. An attempt was also made, as regards one of the earlier cases antecedent to my visit, to determine the exact nature of the disease by transmitting to Dr. Hime, of Bradford, a sample of a stool for bacteriological examination. It was reported, however, that the quantity sent was insufficient for the purpose. On the 21st of August Dr. Newby, Medical Officer of Health for the Urban Sanitary Districts of Grimsby and Cleethorpe-with-Thrunscoe, wrote for the first time to the Local Government Board on the subject of choleraic disease in his districts. He informed the Board that three deaths had been registered in the districts under his charge as due to "cholera nostras"; that these deaths occurred on the 11th, 15th, and 20th respectively; and that the medical attendant had stated in regard of one case that "she had every symptom of cholera (Asiatic)," though he certified the death as from "cholera nostras." In view of these facts and of the occurrence at Hull of a definite case of cholera, I was, as I have said, ordered by the Board to visit Grimsby on the 29th August, and on the 31st of the month Dr. Klein stated, in regard of material submitted by me to him from a fatal case at Grimsby, that the disease was, in his opinion, Asiatic cholera. From that date the Sanitary Authority lost no time in making further arrangements to grapple with the disease.

The Local Government Board sanctioned on September 1st the exercise of the powers conferred upon Sanitary Authorities by section 133, Public Health Act, 1875, by the Great Grimsby Urban Sanitary Authority and the Grimsby Port Sanitary Authority, and a cholera sub-committee was appointed, composed of the Mayor (Mr. Doughty), Aldermen J. K. Marshall (Chairman) and Mudd, and Councillors Mundahl and Brown.

The project of having hospital tents from London, which had formerly been entertained by the Sanitary Authority, was now given up, and a staff of workmen was employed day and night altering the old fever hospital to render it suitable for the reception of cholera cases.

* The fee for notification was withdrawn on September 11th, although a few notifications were received up till the morning of September 13th.

The hospital was placed under the medical charge of Mr. H. J. M. Watts, and the nursing arrangements were entrusted to Miss Jackson, who had a staff of nurses working under her orders. There was already on the hospital premises a Washington Lyons steam disinfecting apparatus.

Dr. Bruce was appointed to devote his whole time to the duty of Assistant Medical Officer of Health, and to personally superintend all the work undertaken with a view to suppression of the cholera.

Epidemic Regulations were issued by the Local Government Board for Grimsby Urban Sanitary District, and Cleethorpe-with-Thrunscoe Urban Sanitary District, and Grimsby Port Sanitary District on September 1st, and on September 6th Supplementary Regulations were issued rendering choleraic diarrhœa notifiable whether the Infectious Disease (Notification) Act, 1889, was in force or not.

The Cholera Sub-Committee, on September 6th, requested the medical practitioners of the town to meet them at the Town Hall, and most of the medical men attended. The Chairman explained the Epidemic Regulations, a copy of which had been sent to each medical man, and asked them to appoint six of their number to act as medical visitors. This they refused to do, and the meeting terminated. The sub-committee then procured the services of seven medical men, all strangers to Grimsby, at a salary of seven guineas a week each, with board and lodging, to act as medical visitors, six being assigned districts in the town and one being given charge of the docks.

The "boxes" for excreta were at once removed from the premises of houses in which cases of choleraic disease were notified; such boxes were burnt and metal pails were substituted. The contents of these pails were disinfected, taken to the night soil depôt, beyond the West Marsh, on the remote side of the railway line, just within the borough boundary, and there mixed with sawdust and petroleum and burnt. Later on this procedure was carried out in the hospital grounds in a destructor specially set up for the purpose. In some cases the excreta had passed into "cesspools" before the Sanitary Authority became aware of the illness, and as soon as this became known such "cesspools" were cleaned out and disinfected.

The town was divided into districts for scavenging purposes, and a foreman with a staff of scavengers appointed to each.

Arrangements were made with the Grimsby Nursing Institute and with the Stoke Nursing Institute for supplying trained nurses for the sick at their own houses.

All the dead were wrapped in sheets, soaked in carbolic acid, and the Inspector of Nuisances saw each body placed in the coffin and taken to the cemetery there to be buried in chloride of lime; he also stayed at the cemetery until the grave was filled in.

All persons were turned out of any house where a death from disease of the nature of cholera had taken place, and the Sanitary Authority took possession thereof until the house had been disinfected by washing with disinfectants and lime washing. All bedding, clothes, &c., that by any chance had become contaminated were soaked in a disinfectant and taken away and burnt.

A house of refuge was provided by the Sanitary Authority for persons who, for the purpose of disinfection of their premises, were turned out of their houses.

A house-to-house inspection was carried out by the Medical Visitors, who also in addition to treating the sick in emergency made special reports on the sanitary condition of the houses and on their districts generally.

Dr. Rogers, the Medical Visitor placed in charge of the docks, attended each tide, *i.e.*, every twelve hours, and examined the crews of the coasting vessels and fishing smacks on their entrance into dock.

The first fishing smack which was reported as having cholera on board was the "Speculator." She left Grimsby, August 29th, with a crew of four hands, and not having touched at any port returned to Grimsby on September 1st. One of the deck hands, W. B., aged 52, who resided when at home at 47, Guildford Street, New Clee, Grimsby, had been attacked with choleraic symptoms on the day of sailing. He was recovering when he was transferred to the hospital ship "Bradford." From the same smack W. L., aged 57, was also removed to the Hospital Ship on September 1st. He usually lived entirely on the vessel and had been attacked on August 30th. He also recovered. A few other cases were removed to the Hospital Ship, and certain cases of choleraic illness in the town were traced to the smacks, but their number was small. There is, however, little doubt that diarrhœa existed among the crews of these smacks, though but little in comparison with the diarrhœa in the town.

The work of the Cholera Sub-Committee and of the officers of the Sanitary Authority was no sinecure. There was dissatisfaction among the medical men of the town, many of whom failed to realize the necessity for the action taken by the Sanitary Authority in instructing the Medical Officer of Health to visit notified cases, with a view to decide under Article 12 of the Epidemic Regulations, on the necessity or otherwise of such cases being taken to the cholera hospital. And one of them wrote to the Medical Officer of Health to the effect that under these circumstances he must decline, with probably (he said) the majority of the practitioners in Grimsby, to notify any further cases: stating inter alia that he considered that in these days of competition he could not afford to introduce whomsoever the Sanitary Authority might think fit to his private patients. That such inspection of patients was rightly undertaken by the Sanitary Authority became sufficiently evident. There were medical practitioners in Grimsby employing unqualified assistants, and, in one instance, I was informed that one of these assistants had diagnosed "suppressed menstruation," whereas, on seeing the case, the Medical Officer of Health, the Assistant Medical Officer of Health, and myself, and afterwards Mr. Watts, the Medical Officer in charge of the hospital, considered that the case was one of well-marked typhoid fever. Again, it was judged necessary to inspect each case on its being notified, since a particular case that had been notified as mere "diarrhœa" was found a few hours later moribund from cholera. And on a particular day three cases of "diarrhœa" which were notified, were deemed by the Sanitary Authority to be "choleraic," and the patients removed to the hospital. In justice, however, to the medical men of Grimsby as a whole, I must state that at their hands I received nothing but courtesy, and everything that they could do was done to help me in my inquiry. Again, there were letters written to the local press by members of the Sanitary Authority, in which the action of the Cholera Sub-Committee was severely criticised.

All these things seriously handicapped the efforts of the Cholera Sub-Committee, who are deserving of commendation for the efficient way they acted in the emergency; and it is essentially due to them, and to the energetic action of their officers, that cholera did not obtain a firmer footing in the town.

I consider, however, that the Sanitary Authority made a serious mistake in not insisting on the ship "Elizabeth" being removed from the dock when she was certified by the Port Medical Officer of Health

to be infected with cholera. And this error was followed by manifestly weak action as regards the "Infective Diarrhœa" which was dealt with on board the ships in the Alexandra and Union Docks. None of these ships were ordered out of dock. They were merely washed down with carbolic acid solution and the closets cleaned out, they were not fumigated. The excrement of persons sick on board them was in nearly every case passed into the docks.

Among the lowest classes great ignorance and indifference were displayed. Many people were unable to read the notice left at their houses by the Sanitary Authority. Many who could read did not comprehend the meaning of the word "diarrhœa" and took no trouble to find out.

At a common lodging-house a man who had symptoms of cholera was found in a double bed. His bed companion, an elderly man, seemed utterly indifferent to the fact that his fellow lodger was acutely ill.

At one time, however, something like panic seized upon a few of the inhabitants. In a particular instance, on a death occurring, the Sanitary Authority had to break into the house to obtain possession of the body for burial, the occupants having locked up the house and made a hurried departure to Sheffield.

The undertakers' men refused for some time to deliver the coffins inside the invaded houses or to place the dead bodies in the coffins. A climax was reached when a coachman refused to drive the hearse. In these circumstances the Assistant Medical Officer of Health and the Inspector of Nuisances went by night and removed the dead in the ambulance to the hospital mortuary to await burial while the houses were disinfected.

There would appear to be but little doubt that the Sanitary Authority, to say the least, suspected that they were dealing with cholera at the very beginning of the epidemic, and that the matter was not made public for fear of affecting the trade of the town. The result was that the hospital was not prepared, the patients were not moved to hospital, and for ten days no sufficient action was undertaken in limiting the spread of the disease. If the first suspected cases could have been taken into the hospital it is possible that Grimsby might have been secured against further cholera. And the influence of this fear of losing trade could be traced throughout the epidemic. There were many persons in the town who would have been pleased to have hushed the matter up, and in their wisdom—wisdom which takes no heed for the morrow—would have been content to keep the fact of cholera being in Grimsby a fact known only to themselves. Regard for advantage in business was allowed to dictate what should be done at the moment; Grimsby itself, and the country at large to a less extent, being the sufferers.

Cleethorpe-with-Thrunscoe.

The Sanitary Authority consists of a chairman and eleven members. The administration devolves upon the Medical Officer of Health (Dr. Newby), an Inspector of Nuisances, and the Surveyor, who is also the clerk to the authority.

There is no accommodation for the isolation of infectious disease in the district, and when the choleraic disease appeared in the district the Sanitary Authority were quite unprepared to meet it.

In 1892, the Cleethorpe-with-Thrunscoe Urban Sanitary Authority met the Great Grimsby Urban Sanitary Authority in conference, and it was arranged that, when a hospital for infectious disease was built at

Grimsby the Cleethorpe-with-Thrunscoe Authority should combine with the Great Grimsby Authority in the undertaking. Nothing more was, however, done in the matter, and, as already stated, the advent of cholera found the Cleethorpe-with-Thrunscoe Urban Sanitary Authority unprepared.

On it becoming known that a death from undoubted cholera had taken place in Grimsby, the Urban Sanitary Authority of Cleethorpe-with-Thrunscoe sent a deputation to the Sanitary Authority of Grimsby. I attended the meeting. It was arranged that the Cleethorpe-with-Thrunscoe Authority should send their cholera sick, when such cases were fit for removal, to the hospital at Grimsby, and that they should, as far as possible, adopt similar sanitary precautions to prevent the spread of the disease as were being adopted by the Grimsby Urban Sanitary Authority.

Medical Visitors, a new Inspector of Nuisances, and extra scavengers were appointed, and in other respects, also, the Epidemic Regulations, which were issued to the Cleethorpes Urban Sanitary Authority at the same time that they were issued to the Grimsby Urban and Port Sanitary Authorities, were carried out. Hand bills were issued and placards posted similar to those of the Grimsby Urban Sanitary Authority.

From the foregoing account it may be seen that cholera and choleraic diarrhœa were not prevalent to any great extent in Grimsby or Cleethorpes in 1893. The continued maintenance of disease of the nature of cholera in the former place for some considerable time, and the extensive prevalence there of diarrhœa and typhoid fever, are facts that should seriously engage the attention of the Sanitary Authority. The sewerage systems of both districts are now under revision, and I have directed attention to the defects of the "box" system of excrement and refuse disposal. It is doubtful whether the private wells of Grimsby and of Cleethorpes are free from risk of pollution, and doubtful also whether they have not had some share in the maintenance and spread of choleraic disease. They should be severally examined with a view to ascertaining any possible sources of contamination of their water. The necessity of having proper isolation accommodation ready for immediate use has, I should hope, been sufficiently brought home to the Sanitary Authorities during the summer of 1893.

The necessity for an Assistant Medical Officer of Health at Grimsby during the epidemic, devoting his whole time to the duties of his office, was made evident last year, and it behoves the Sanitary Authority to consider whether whole time service from their Medical Officer of Health should not be arranged for.

The great trade of the town, the fish trade, is one calling for constant care and watchfulness on the part of the Sanitary Authority, and an additional Inspector of Nuisances for the fish docks would be an advantage.

The large number of trippers,* principally from manufacturing towns, who visit Cleethorpes is a constant source of danger in so far as the importation and exportation of infectious disease is concerned, and the absence of the adoption by the Sanitary Authority of that place of the Infectious Disease (Notification) Act, 1889, renders anything like prompt action on the part of their Medical Officer of Health almost an impossibility.

* In the six months May to October 1893, no less than 235,721 excursionists were booked to Grimsby and Cleethorpes by the Manchester, Sheffield, and Lincolnshire Railway alone.

Before closing this report I must express my sense of the kindness and courtesy invariably extended to me and the help which I received during my investigations at Grimsby and Cleethorpes. And I here take the opportunity of thanking the Mayor, Aldermen, and Councillors and the medical practitioners of Grimsby; the members of the Sanitary Authority of Cleethorpe-with-Thrunscoe, and Dr. Pickford of Cleethorpes, Dr Moody, the coroner, Dr Leppington, the Registrar; the officers of the Manchester, Sheffield, and Lincolnshire Railway Company; the officers of Her Majesty's Customs, the Managers of the Steam Laundries, and the Manager of the Great Grimsby Waterworks, and several other gentlemen.

But especially I must express my appreciation of the untiring energy of, and of the valuable assistance rendered to me by, Mr Alderman J. K. Marshall, the Chairman of the Cholera Sub-Committee; as well as of the help afforded me by Drs. Newby, Bruce, and Simpson, the Medical Visitors, and the Inspector of Nuisances. To Mr. Peto, the Borough Surveyor of Grimsby, I am also indebted for much help as regards maps and diagrams.

ADDENDA.

A. Growth of Grimsby.
B. Docks and General Trade of the Port.
C. Oyster Trade of Cleethorpes and Grimsby.
D. Mussel and Cockle Trade.

A.

The borough of Great Grimsby is of ancient date, its charter having been granted by Edward III. Even in those days Grimsby was interested in the shipping trade, and had to provide a fleet of 10 ships and 171 men for the siege of Calais. Its rise into importance in recent times dates from about the year 1800, when the first dock was constructed, the population in 1801 being only 1,524. The commerce of the town was augmented by the opening up of railway communication in 1848, and by the development of the fishery industry and foreign trade.

Until recently the borough of Great Grimsby contained 1,838 acres, and the population was, at the census of 1861, 11,067; in 1871, 20,244; in 1881, 28,503. Between 1881 and 1891 the boundary of the borough was altered, the New Clee and Wellow Weelsby area being added, and the acreage increased to 2,832 acres. At the census of 1891 Grimsby contained 10,631 inhabited houses, and a population of 51,934 persons. These figures for the corresponding district in 1881 would be: inhabited houses, 7,612; population, 40,010. Thus it may be seen that the district has been increasing rapidly both as regards the number of inhabited houses and the number of the population. This increase is still being maintained. A great portion of the district is distinctly urban. Wages are good, and the inhabitants are as a rule well-to-do. Whole streets in the town have been built by the working classes—each house by the occupier—through the aid of building societies; and as a consequence many houses are exactly alike, each building society having its own model. There does not exist in the town any portion where squalor and filth can be said to be conspicuous. The least clean part of the town is, as might be expected, that portion lying near the fish dock, and where the fish curing is carried on. Here in the driest day in summer the streets and approaches to the docks are muddy, due to the melting of the ice used in the fish trade, the water dropping on to the roads from the boxes of fish.

B.

Docks and General Trade of Grimsby.

The Grimsby Docks were commenced about the year 1800, and have since been improved and extended from time to time. The Royal Dock was opened in 1858, and the Alexandra Dock in 1879. A small dock—the Union Dock—connects the Alexandra and Royal Docks. In the main, the timber trade goes to the Alexandra and Union Docks, the continental traffic to the Royal Dock, and the fish trade to the Fish Docks. The docks are substantially built and are kept in good repair. Means for thoroughly flushing the docks do not exist. The dock gates are opened before high water and closed on the ebbing tide, consequently there is not more than some six feet rise and fall in the waters of the docks. Situated along the sides of the docks are warehouses for storing merchandise. The fish pontoon is of course situated in the Fish Docks. A deposit of sand tends to silt up the entrance to the docks, and requires constant attention on the part of the authorities.

The trade of Grimsby is such that the town is exposed to constant danger when an epidemic disease, such as cholera, exists on the Continent. Six steamers arrive at Grimsby every week from Hamburg, two steamers

App. A. No. 2. Great Grimsby and Cleethorpes in 1883, by Dr. Reece.

a week each from Antwerp, Rotterdam, and Dieppe, and one steamer a week each from Ostend, Malmo, and Esbjerg. Boats from the three last-named ports bring immigrants. Occasional steamers come from the French ports. In addition, there are the relations at sea of the Grimsby fishing fleet with the "coopers." "Coopers" are vessels which hail from the Dutch coast, and carry on a contraband trade in spirits, &c., with the fishing fleet. Grimsby is also in constant communication with Hull, both by water and land, and many of the crews of vessels discharging at Hull live at Grimsby or Cleethorpes.

C.

OYSTER TRADE OF CLEETHORPES AND GRIMSBY.

It having been stated in several quarters that persons who had partaken of oysters from Grimsby and Cleethorpes had died a short time afterwards with symptoms of Asiatic cholera, I made investigation of the conditions under which the oysters trade of the district is carried on.

The oyster beds are situated off Cleethorpes, and are distant about 1½ miles from high-water mark. They are partially uncovered only at the very lowest tides. The map of the coast annexed to this report shows the position of these beds. The flowing tide sets directly in at right angles to the coastline, and the ebbing tide runs outwards in the same direction of the waters brought down by the Humber River.

There are at Cleethorpes four dealers in oysters—Messrs. M., O., L., and C. Messrs. M have the largest trade. Their firm possesses oyster beds in America, Ireland, Zeeland, Sutton, Brightlingsea, Cleethorpes, &c. Messrs. O. also have a large trade, but it is principally connected with Cleethorpes, as is also the trade of Messrs. L. & C.

It would appear that oysters are imported from America and the Dutch and Danish coasts, and laid down on the Cleethorpes beds in the spring of the year. At other times the imported oysters go direct to the market. The trade at Cleethorpes for the year is practically over in September.

In the usual course of events, the oysters are brought ashore, and, if their shells are dirty, are placed in a sieve shaped as a pail, and then washed at a tap with water from the Great Grimsby Water Company's Works. They are then placed in sacks for short journeys, or in barrels if travelling to a distance. They are despatched to their destination the same day that they are brought ashore from the beds.

The oysters are sent to all parts of England, to Russia, Denmark, France, and to most European countries. The firm of Messrs. O sends away from Cleethorpes 400,000 oysters per week in the season; and this fact, coupled with the circumstance that the cholera attacks which had occurred in connexion with oyster-eating were but few, was referred to by a member of this firm as a ground for disbelieving that Cleethorpes oysters gave people cholera. Both this gentleman and Messrs. M said that it was, of course, quite possible that local tradesmen kept the oysters too long in their shops, and that although in winter oysters might be kept a week or 10 days, it was not advisable to keep them in the summer more than three days. By the courtesy of Messrs. M. I was allowed to see the books of the firm. On August 17th, a date I took at random, the firm had sent away many thousands of oysters to nearly every part of England.

The various firms employ locally—

Messrs. M.	- - - - - -	16 men.
Messrs. O.	- - - - - -	16 ,,
Messrs. L.	- - - - - -	4 ,,
Messrs. C.	- - - - - -	3 ,,

Additional hands are taken on during the season as the work requires. All the men employed by the above firms are at liberty to eat any number of oysters they may feel disposed to partake of. Only two men employed by these firms had diarrhœa during the summer.

There are at Cleethorpes several "bars" where oysters are sold to residents, visitors, and trippers during the summer months. Many of these bars are closed by the end of September. During my inspection of the place I visited all that were open and conferred with all the proprietors who could be found. I learnt that these tradesmen buy all their oysters from one of the firms previously mentioned, and that they only have a small quantity at a time; they send down to one of the wholesale firms as often as three or four times a day for a fresh supply when trade is brisk. I did not learn that oysters were kept in stock at Cleethorpes more than two days. Only at two of the bars were the oysters washed or dipped in water after opening the shell. In each of these cases the water used was tap water. At the other "bars" I was told that such a procedure would spoil the flavour of the oyster.

At Grimsby the local oyster trade is mostly in the hands of the firm of Messrs. O., mentioned above. These oysters are brought from Cleethorpes as they are required. The surplus stock is placed in "floats" inside the Fish Dock. These "floats" are large wooden trays, some 15 ft. × 10 ft., placed by the dock-piers, behind buttresses. The "top of the tide" flows over the buttress into the floats, and supplies them afresh with tidal-water twice in 24 hours. The oysters are not kept in these floats for any length of time, and the floats were mostly empty in September.

Oysters and Cholera.

It deserves to be borne in mind that about one million oysters were distributed from the Cleethorpes oyster beds each week last August, in all parts of the country, the fact, therefore, that a few persons suffered cholera soon after,consuming oysters presumably from this source, appears, at first sight, to have no particular significance.

Nevertheless, a glance at the map of the coast that is annexed to this report will show that there is certainly a possible chance that the incoming tide may wash back Grimsby and Cleethorpes sewage over the oyster beds, and that the outgoing tide may deposit sewage matter on the oyster beds. But however this may be, the sewage in question must be profusely diluted by the large volume of water running out of the Humber.

It would seem indeed that the Grimsby oysters, on the floats inside the Docks, are more liable than oysters on the Cleethorpes beds to contamination, lying as they do in proximity to Grimsby Fish Dock sewer outfall. None of these oysters, however, have been complained of as associated locally with production of cholera, though this by no means proves that they have not had to do with causation of the disease.

In this connexion it is, however, of interest to note that I was informed that when the local Sanitary Authority laid the principal facts of a recent bacteriological examination of the dock-water before the representatives of the Manchester, Sheffield, and Lincolnshire Railway Company at Grimsby, the latter, not being in a position to refute the facts, charged the Sanitary Authority with polluting the water by the sewage from the outfall near the Fish Dock being carried back into that Dock.

D.

Mussel and Cockle Trade.

The firm of "Messrs. M.," mentioned above, have also a large "mussel" trade. This trade is worked under conditions practically identical with their oyster trade. The mussels are laid down in beds adjoining the oyster beds at Cleethorpes, and they are stored, washed, and despatched to various places in the same way as are the oysters. This firm have no "floats" in the Grimsby Docks.

There are numerous mussel beds along the coast, and mussels may be seen adhering to the sewage pipes; but only at Cleethorpes are they "farmed."

The mussels on the "open" beds are eaten locally: they are collected in small quantities for that purpose. No large or definite trade is done except by Messrs. M 's firm.

Mussels, generally, on this part of the coast are more exposed to sewage than the oysters.

Cockles.

There is a large bed of cockles lying between the Grimsby sewer outfall by the Fish Docks, and the Beaconthorpe sewer outfall of Cleethorpes. Owing to the position of this cockle bed, it is, of course, exceptionally exposed to the influence of Grimsby and Cleethorpes sewage [illegible]. Cockles are gathered by local people all along the coast, generally in small quantities, for consumption in the district.

In view of a seeming association between early cases of cholera and the consumption of cockles, inquiries were made into the uses to which cockles were put. As the result I was informed that cockles are cooked, usually by boiling, before being eaten. It does not appear that they are often eaten raw.

There does not appear to be any definite trade in cockles.

Hospital Ship ..... BRADFORD.

BOROUGH OF Gt GRIMSBY. MAP I.

NOTIFICATIONS OF CHOLERA, CHOLERAIC DIARRHŒA, AND CHOLERA NOSTRAS. 1893.

Wyman & Sons, Lt. Lith. 63 Carter Lane E.C.

BOROUGH OF GT. GRIMSBY. MAP II.

DEATHS FROM CHOLERA, CHOLERA NOSTRAS, AND CHOLERAIC DIARRHŒA. 1893.

Wyman & Sons, Lt.e Lith. 63, Carter Lane, E.C.

Borough of Gt Grimsby. Map III.

Cases of Diarrhœa Notified 6th to 13th September. 1893.

Wyman & Sons, Ltd. Lith. 63 Carter Lane

BOROUGH OF GT GRIMSBY. MAP IV.

NOTIFICATIONS OF TYPHOID FEVER 1893.

Wyman & Sons, Ltd. Lith, 63, Carter Lane, E.C.

BOROUGH OF GT GRIMSBY. MAP V.

LOCATION OF PUMPS.

Wyman & Sons, Ltd, Lith. 63, Carter Lane 6/92 7.94.

PLAN, SHEWING POSITION OF 5 FATAL CASES OF CHOLERA.

RIVER HUMBER

GRIMSBY SEWAGE OUTFALL

GRIMSBY SEWAGE OUTFALL

COCKLE BEDS

BEACONTHORPE SEWAGE OUTFALL

CHAMBER

NORTH WEST WARD

HUMBER WARD

NORTH EAST WARD

GREAT GRIMSBY

SOUTH WEST WARD

WELLOW WEELSBY WARD

SOUTH WARD

C L E E

Acres 2556·406

GREAT GRIMSBY

Acres 2161·420

CLEETHORPE

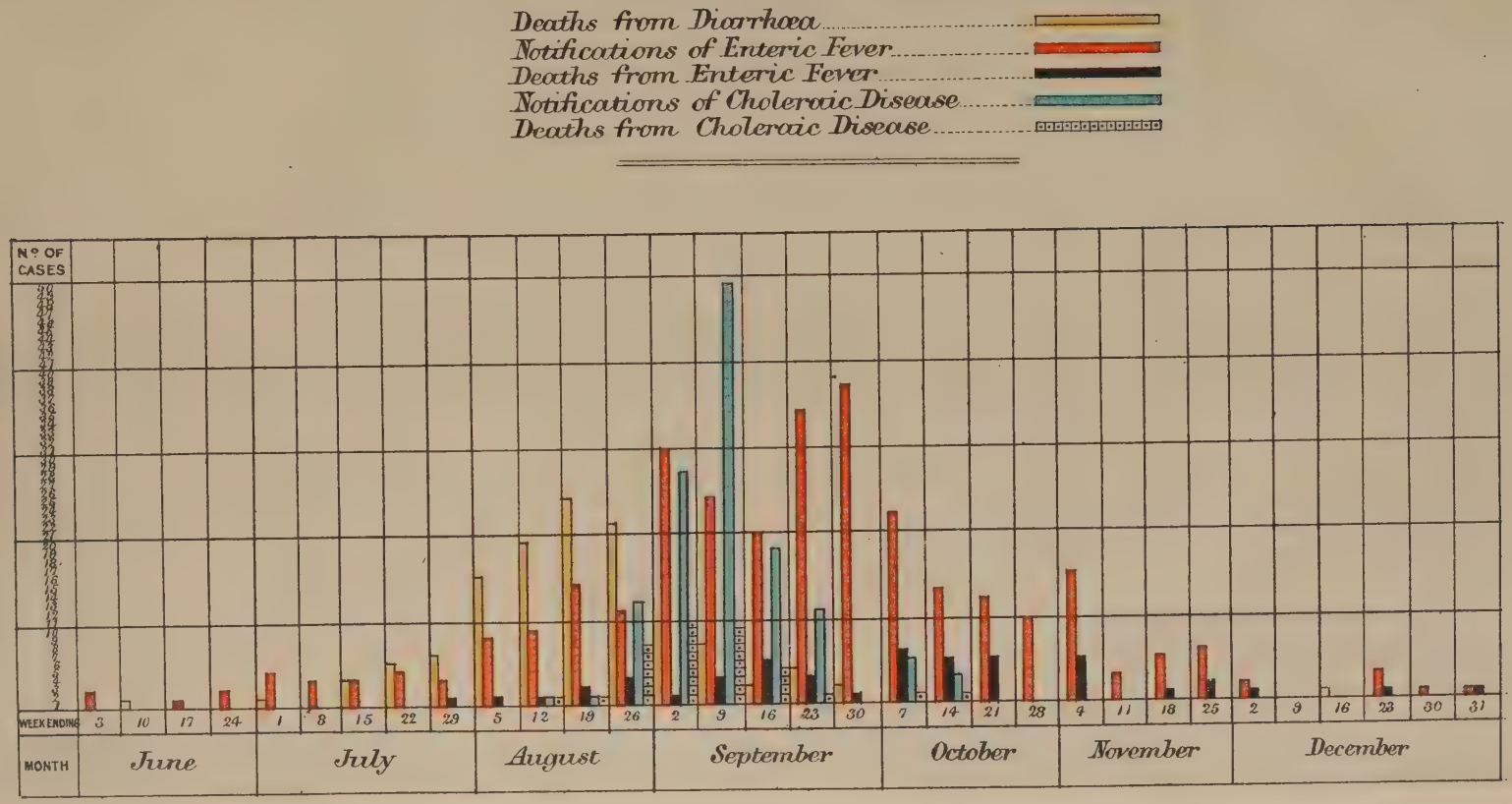
OYSTER & MUSSEL BEDS

Cleethorpes

HUMBERSTONE BECK SEWAGE OUTFALL

Wyman & Sons Ltd Lith

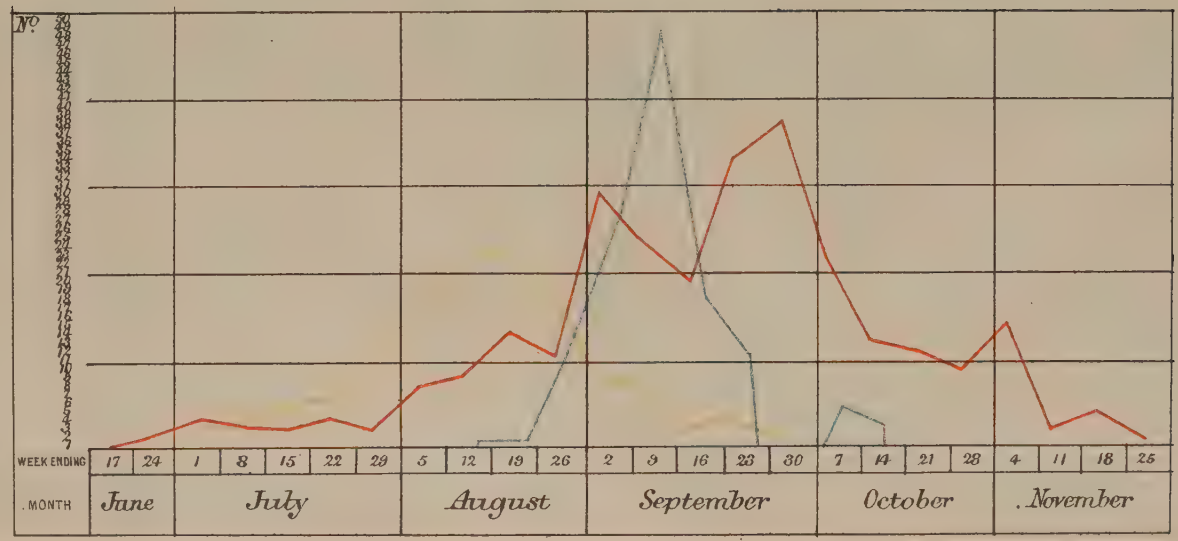
CHART I. *Showing the Deaths from Choleraic Disease, Enteric Fever, and Diarrhœa, and the notifications of Choleraic disease, and Enteric Fever, in the Great Grimsby U. S. District, during 1893. Corresponding to Table VI.*


Deaths from Diarrhœa
Notifications of Enteric Fever
Deaths from Enteric Fever
Notifications of Choleraic Disease
Deaths from Choleraic Disease
No. OF CASES
WEEK ENDING
3 10 17 24 1 8 15 22 29 5 12 19 26 2 9 16 23 30 7 14 21 28 4 11 18 25 2 9 16 23 30 31
MONTH
June
July
August
September
October
November
December

WYMAN AND SONS LTD LITH 63 CARTER LANE 6480.10.94.

CHART II. *Shewing the number of Cases notified of Choleraic Disease, and Enteric Fever, and the number of Deaths attributed to Diarrhœa during the months of June – November 1893, in the Great Grimsby Urban Sanitary District.*

Deaths attributed to Diarrhœa
Notifications of Enteric Fever
,, ,, Choleraic Disease



WYMAN AND SONS LTD LITH 63 CARTER LANE 6480 10.94.

No. 3.

Report on Cholera in the Borough of Kingston-on-Hull in 1893; by Dr. Theodore Thomson.

On the 24th of August 1893 a boy, eleven years of age, residing at 6, Havelock Terrace, Dansom Lane, Hull, was attacked by an illness from which he died on the same day. The following are the facts of the case.

The boy, who was in his usual health on August 23rd, awoke on the morning of August 24th about 5 o'clock, vomited a little and passed a loose motion. He had a similar attack at 6.30 a.m. and again at 9 o'clock a.m. Apart from these symptoms he is said to have appeared well and comfortable, and, in consequence, no medical man was called in. He took some nourishment in the form of cornflour and milk at 9 a.m. and again at 10.30 a.m. At the latter time he complained of aching pains in the calves of his legs. It is said that no aggravation of symptoms occurred until about 2 p.m. when, according to his mother, he "turned a peculiar colour," which so alarmed her that she gave him some brandy and sent for a doctor. The boy, however, died about 2.40 p.m., just before the doctor arrived. There was no diarrhœa nor vomiting after 9 a.m. On the following day, August 25th, an inquest was held on the body of deceased, and the jury returned a verdict that "death was caused by shock and collapse due to enteric "discharges from the bowels from acute causes." With the view of arriving, if possible, at a clearer appreciation of the cause of death, a portion of the lower bowel (ileum) of deceased was forwarded by the Sanitary Authority to Dr. Klein for bacterioscopic examination. This piece of ileum was received by Dr. Klein on August 28th, and on the following day he announced that the material sent him had afforded unequivocal indications of true cholera.

I had already, on August 28th, been instructed by the Board to visit Hull; and this I did on August 29th, making inquiry there on that and on days immediately following, as well as on several subsequent occasions. On the information thus obtained is based the account I now proceed to give of cholera in Hull in 1893 and of the circumstances under which it occurred there.

At an early stage of my investigations I sought to ascertain whether there had appeared in Hull prior to August 24th cases of disease which might have really been of a choleraic nature, although not definitely recognised as such at the time of their occurrence. As result I found that on August 16th a man, aged 61 years, and residing in a common lodging-house (also in the neighbourhood of Dansom Lane), had been attacked by diarrhœa, which became so severe on the following day, August 17th, that a medical practitioner was called in to attend him. When seen by the medical man on the latter date, the patient was confined to bed and was in a prostrate condition. His temperature was not higher than 97° Fahr.; his pulse was 100 and intermittent; his features were contracted; his voice was faltering; and he suffered from cramps, vomiting, and purging. During the course of the day, however, his illness abated; and he subsequently made a rapid recovery. Owing to his stools having been received in a pail containing disinfectants, bacterioscopic investigation had not been made in this instance. With the single exception of this case, inquiry failed to reveal the occurrence of attacks presenting choleraic symptoms in Hull in 1893 prior to August 24th. Thenceforward, therefore, attention was directed to the behaviour of cholera in the town subsequent to the date in question.

The fatal manifestations of choleraic disease in Hull, as illustrated by the *deaths* referred to cholera and to choleraic diarrhœa respectively, are recorded in the following table (Table I.). No deaths were in 1893 attributed to either of these causes prior to August 24th: nor during the period August 25th to 31st, both dates inclusive: nor after October 10th.

TABLE I.

Showing—(1.) DEATHS certified as due to CHOLERA in HULL (estimated population, 208,709) during the Period August 24th to October 10th, 1893.

Date of Death.	Sex.	Age.	Occupation.	Duration of Disease.
August 24	Male	11	Son of labourer	10 hours.
September 1*	Female	56	Widow of labourer	Not stated.
„ 3	„	19	Daughter of labourer	„ „
„ 4	Male	44	Labourer	24 hours.
„ 6	„	65	Labourer	24 „
„ 6	Female	48	Wife of labourer	8 „
„ 13	Male	40	Labourer	24 „
„ 18	„	64	Labourer	Not stated.
„ 18	„	27	Stereotyper	3 days.
„ 24	Female	35	Wife of oilmiller	1 day.
„ 25	Male	63	Fruiterer	2 days.
„ 26	„	53	Road contractor	30 hours.

And—(2.) DEATHS certified as due to CHOLERAIC DIARRHŒA in HULL during the Period August 24th to October 10th, 1893.

Date of Death.	Sex.	Age.	Occupation.	Duration of Disease.
September 3	Male	65	Innkeeper	Not stated.
„ 7	Female	68	Widow of retired gentleman	„ „
„ 11	„	11	Daughter of hairdresser's assistant	4 days.
„ 23	„	42	[illegible]	24 „
October 10	Male	9	Son of blacksmith's striker	Not stated.

It is thus seen that in Hull in 1893, 12 *deaths* were ascribed to cholera and 5 to choleraic diarrhœa; in all 17 deaths from choleraic disease, corresponding to a death-rate from this cause of 0·08 per thousand of population.

As to prevalence of choleraic *illness* in Hull, exceptional information is available for the period September 7th—October 12th, during which

* Material (blood) from this case was sent to Dr Klein for bacteriological examination. Briefly the history of the patient is as follows:—She was seized with diarrhœa on August 31st. In the course of the night following the diarrhœa became severe and was accompanied by cramps, abdominal pain, and vomiting. She was first seen by a medical man about 6 a.m. on September 1st, and was then in a state of collapse with husky voice and blue extremities. She died at 11.20 a.m. on the same day.

time medical men practising in the borough certified at the request of the Sanitary Authority all cases of "choleraic diarrhœa" that came under their notice; cases of cholera being meanwhile notified in the usual way in accordance with the provisions of the Infectious Disease (Notification) Act, which is in force in Hull. And in addition the Sanitary Authority gained knowledge of cases of choleraic disease through their own officers and in other ways. I am able, accordingly, to annex a table (Table II.) in which are enumerated day by day attacks of a choleraic character in Hull which came in one and another way to the knowledge of the Sanitary Authority between August 24th and October 12th. In considering, however, the data formulated in this table it must be borne in mind that prior to September 7th medical men had not been informed that notifications of choleraic diarrhœa would be paid for, and that accordingly cases coming to the knowledge of the Sanitary Authority during the period August 24th to September 6th were likely to be few relatively to those that became known on September 7th and following days.

Table II.

Showing, day by day, the Number of Cases of Cholera and Choleraic Diarrhœa known to have occurred in Hull during the Period August 24th to October 12th, 1893.

Date.	Number of Persons attacked by Cholera.	Number of Persons attacked by Choleraic Diarrhœa.	Date.	Number of Persons attacked by Cholera.	Number of Persons attacked by Choleraic Diarrhœa.
August 24	1	—	September 18	2	6
„ 25	—	—	„ 19	—	2
„ 26	—	—	„ 20	—	7
„ 27	—	—	„ 21	—	4
„ 28	—	—	„ 22	1	2
„ 29	—	—	„ 23	—	—
„ 30	—	—	„ 24	1	2
„ 31	—	—	„ 25	—	2
September 1	—	—	„ 26	1	2
„ 2	—	1	„ 27	—	2
„ 3	2	—	„ 28	—	1
„ 4	2	—	„ 29	—	2
„ 5	3	—	„ 30	—	2
„ 6	2	14	October 1	—	—
„ 7	—	29	„ 2	—	1
„ 8	—	16	„ 3	—	2
„ 9	—	10	„ 4	—	1
„ 10	—	4	„ 5	—	—
„ 11	—	6	„ 6	—	—
„ 12	1	9	„ 7	—	—
„ 13	—	3	„ 8	—	—
„ 14	—	6	„ 9	—	—
„ 15	1	6	„ 10	—	1
„ 16	—	6	„ 11	—	1
„ 17	—	2	„ 12	—	—

Total number of persons known to have been attacked by cholera from August 24th–October 12th - - - - - - 17

Total number of persons known to have been attacked by choleraic diarrhœa from August 24th–October 12th - - - - 152

From the above table it appears that during the period August 21st to October 12th, 169 persons were, within the knowledge of the Sanitary Authority, attacked by sickness believed to be of a choleraic nature. Of this total 17 were classified as cholera, and 152 as choleraic diarrhœa. It is desirable, however, not to attach any considerable importance to the distinction thus made. For, during the period covered by Table II., 12 deaths were ascribed to cholera; and the cholera fatality ($\frac{12}{17}$) thus arrived at is so high as to afford ground for suspicion that not a few persons in the "choleraic diarrhœa" list really suffered from true cholera. On the other hand there should be hesitation in regarding all cases of "choleraic diarrhœa" as actually having been cases of true cholera. For, on dealing collectively with cholera and choleraic diarrhœa during the period under consideration, we find that not more than 17 deaths occurred among 169 cases of choleraic sickness. The fatality thus arrived at (10 per cent.) is sufficiently low to justify supposition that certain cases returned as "choleraic diarrhœa" were in reality cases of "summer diarrhœa," from a seasonal prevalence of which Hull, like many other places, suffers annually. It is worthy of note also that such attacks by choleraic diarrhœa as came to the knowledge of the Sanitary Authority did so mainly (for reasons already stated) on and after September 7th; and, accordingly, it is probable that, had the sources of information on and after the date mentioned been at the Authority's disposal in weeks antecedent to September 7th, the numbers of recorded cases of choleraic sickness would have been still higher and the fatality from this cause correspondingly more insignificant. These considerations, accordingly, might lead to belief that the number of persons actually attacked by choleraic disease was smaller than the return made to the Sanitary Authority of persons suffering from cholera and choleraic diarrhœa would seem to indicate.

But before accepting the foregoing thesis it becomes desirable to consider what was the nature and what the amount of the so-called "summer diarrhœa" in Hull in 1893. For inquiry in this sense might possibly lead to the discovery that this disease was then unusually prevalent, and, should this prove to have been the case, suspicion would arise that true cholera proving fatal might in part have been included in the "diarrhœa" mortality. Further, the type of the diarrhœa this year in Hull deserves attention, with a view to ascertaining whether it differed from that of other years after a fashion consistent with notable share of it having been in reality choleraic disease. I proceed, accordingly, to consider these two points; and deal, in the first instance, with the amount of diarrhœa known to have occurred in Hull in 1893.

Diarrhœa in Hull in 1893.

Knowledge of the amount of diarrhœa in Hull in 1893 is accessible in two ways. One of these is based on the deaths attributed to this cause; the other is derived from consideration of the number of diarrhœa attacks which came to the knowledge of the Hull Sanitary Authority during the period September 7th to October 12th. Knowledge of the latter sort is due in large part to notification by medical practitioners of cases of diarrhœa coming under their observation during the period September 7th to October 12th;* partly also to discovery of "diarrhœa" sickness by officers of the Sanitary Authority in the course of house-to house investigations consequent on appearance of choleraic disease in the district.

* In response to the Sanitary Authority's request (see p. 2) that notification be given them of occurrence of choleraic diarrhœa in Hull, cases of diarrhœa as well as of choleraic diarrhœa were notified by the medical profession and paid for by the Authority.

The total number of deaths ascribed to diarrhœa in Hull in 1893 was 496, which, the estimated population of Hull in 1893 being 208,709, gives the exceptionally high mortality from this cause of 2·4 per thousand persons living. But the diarrhœa death-rate was, in 1893, unusually high throughout the whole country, and, accordingly, it is necessary for just appreciation of the position of Hull in that year to compare Hull with itself in this respect as regards former years, and the diarrhœa death-rate in the borough in 1893 with that for other towns in the same year. In the absence of figures for complete comparison in the above sense for the whole year 1893, a convenient means of contrast of this kind is at hand in a table published by the Registrar-General in his third quarterly return of each year. It is in this quarter that by far the greater number of deaths from diarrhœa occurs in this country; and in this way, therefore, a sufficiently just means of comparison of diarrhœa incidence on various town districts is afforded. On the data thus provided is based the following table (Table III.), in which is shown the diarrhœa death-rate in Hull in the third quarter of 1893, as well as in the ten years 1883–92; and by which also is afforded means of comparison in these respects of Hull with other towns as well as with England and Wales.

Table III.

Showing (as an Annual Rate), for Hull, England and Wales, "28 great Towns," and "67 other large Towns," the Diarrhœa Mortality of the Third Quarter in each of the Eleven Years 1883-93; and giving in each instance, for purpose of comparison with 1893, the Mean of the Third Quarter Rates of the Ten Years 1883–92.

Third Quarter of the Year.	Rate per 1,000 Population in each Instance.			
	Hull.	England and Wales.	Great Towns.	Other large Towns.
1883 - - -	1·8	1·2	2·1	1·4
1884 - - -	6·0	2·7	4·0	3·2
1885 - - -	0·8	1·1	2·1	1·0
1886 - - -	4·5	2·3	3·7	2·6
1887 - - -	4·1	2·1	3·4	2·2
1888 - - -	0·9	0·9	1·6	1·0
1889 - - -	4·0	1·7	2·6	2·0
1890 - - -	2·6	1·3	2·1	1·4
1891 - - -	1·9	1·0	1·7	1·0
1892 - - -	2·9	1·2	2·0	1·5
Average in 10 Years 1883–92 - -	3·0	1·6	2·5	1·7
1893 - - -	8·4	2·8	3·5	3·8

From the figures in Table III. it appears that the death-rate from diarrhœa in Hull in the third quarter of 1893 greatly exceeded that of any one of the third quarters of the 10 years 1883–92. Further, the data in this table show that while there was indeed exceptional mortality from diarrhœa in the third quarter of 1893 in England and Wales, in the 28 great towns, and in the 67 other large towns, the excess

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above the average was in each instance much less marked than it was in Hull during the same period. So far, therefore, as any conclusion regarding the prevalence of "diarrhœa" sickness may be arrived at from mortality due to this cause, it would appear that Hull in this respect suffered, in the third quarter of 1893, not only more than was usual in that borough, but also relatively, as well as actually, far more than did the remainder of the country.

Further information on this subject is afforded, as already stated, by knowledge of a number of diarrhœa *attacks* during the period September 7th to October 12th. In the following table (Table IV.) is contained a statement of the number of those that came to the knowledge of the Sanitary Authority day by day during the period mentioned.

Table IV.

Showing, day by day, the Number of Persons known to have been attacked by Diarrhœa in Hull during the Period September 7th to October 12th, 1893.

Date.	No. of Persons attacked by Diarrhœa.	Date.	No. of Persons attacked by Diarrhœa.
September 7	38	September 25	12
,, 8	37	,, 26	9
,, 9	30	,, 27	5
,, 10	15	,, 28	4
,, 11	39	,, 29	—
,, 12	56	,, 30	2
,, 13	21	October 1	1
,, 14	10	,, 2	2
,, 15	19	,, 3	3
,, 16	15	,, 4	3
,, 17	4	,, 5	4
,, 18	22	,, 6	3
,, 19	10	,, 7	—
,, 20	13	,, 8	—
,, 21	13	,, 9	—
,, 22	5	,, 10	—
,, 23	7	,, 11	—
,, 24	1	,, 12	—

Total persons known to have been attacked by diarrhœa during the period September 7th–October 12th - - - - } 396

In considering the data provided by the above table, it should be borne in mind that, anterior to the time when medical practitioners commenced to notify "diarrhœa" *sickness* there had been a large amount of diarrhœa in Hull. This will appear from a table (Table VI.) and chart which will, in another connexion, be given at a later stage of this report. Statistics, therefore, as to "diarrhœa" sickness during the period September 7th to October 12th represent only a part, and that probably a small part, of the total "diarrhœa" sickness in Hull in 1893. Subject to this limitation, however, the figures in Table IV. are of value as indicating the amount of known diarrhœa during a considerable part of the time when recognised choleraic disease prevailed in Hull.

Since it appears from the data I have given that in 1893 Hull suffered from diarrhœa not only more than in any year during the previous decade, but also in excess of the remainder of the country in 1893, it is desirable to consider whether this unusual prevalence of diarrhœa was accompanied by departure from the ordinary type of summer diarrhœa as known in this country.

The feature hitherto accepted as differential of ordinary summer diarrhœa from diarrhœal disease of choleraic nature is the dissimilar incidence, in these two classes of malady, of deaths on the population at different ages; and accordingly I proceed to consider cholera, choleraic diarrhœa, and diarrhœa in Hull in 1893 from this point of view.

Age Distribution of Deaths from Cholera, Choleraic Diarrhœa, and Diarrhœa in Hull in 1893.

As already stated, in Hull in 1893, 17 deaths were ascribed to choleraic disease and 496 to diarrhœa. In the following table (Table V.) these deaths are classified in certain age groups.

Table V.

Showing the Number of Deaths attributed respectively to Choleraic Disease and Diarrhœa in Hull in 1893, classified according to their Ages.

Age-period.	No. of Deaths due to Cholera and Choleraic Diarrhœa.	No. of Deaths due to Diarrhœa.
Under 1 - -	—	384
1–5 - - -	—	63
5–15 - - -	3	5
15–60 - - -	9	20
Over 60 - -	5	24
At all ages - -	17	496

From these figures it appears that the incidence of fatal cholera was entirely on persons aged five years and upwards, and especially on these in the age group 15–60, while the "diarrhœa" deaths fell mainly on persons under five years of age. The number of deaths, however, referred to choleraic disease is too small to permit any very definite conclusion being based on them. The "diarrhœa" deaths exemplify the fact that in this country, fatal diarrhœa falls much more heavily on the infantile class than on the adult portion of the community.

The following table (Table VI.) shows the incidence of fatal "diarrhœa" in Hull in 1893 on persons under five and also on persons five years of age and upwards; and affords means of comparing in this respect fatal "diarrhœa" in Hull in 1893 with that in the same place during the seven years 1886–92.*

It will be observed that in Hull in 1893 the age incidence of fatal "diarrhœa," as illustrated by the following table (VI.), did not materially differ from that of the same disease during the seven years 1886–92 in that borough. For in 1893 the ratio of mortality from "diarrhœa" among persons under the age of five to the mortality from that cause among persons aged five years and upwards was 61 to 1; while this

* Data prior to the year 1886 were not available.

ratio during the seven years 1886–92 had been .58 to 1. Accordingly, evidence based on mortality referred to "diarrhœa" at certain age-groups does not tend to encourage belief that this disease in Hull in 1893 showed material departure from the ordinary type of summer diarrhœa there.

Table VI.

Showing Year by Year for the Eight Years 1886–93 the incidence of Fatal Diarrhœa on Persons under the Age of 5 and Persons aged 5 Years and upwards respectively: and affording means of comparison of the Death-rate from this disease per 1,000 Persons living for each of these age-groups during the same Period.

Year.	Persons under 5 Years of Age.				Persons aged 5 Years and Upwards.					
	Estimated Population.	Number of Deaths from Diarrhœa.	Diarrhœa Death-rate per 1,000 living.	Average Death-rate per 1,000 living from Diarrhœa, 1886–92.	Estimated Population.	Number of Deaths from Diarrhœa.	Diarrhœa Death-rate per 1,000 living.	Average Death-rate per 1,000 living from Diarrhœa, 1886–92.	Ratio of Diarrhœan Mortality at Ages 5 and upwards to that at Ages under 5 Years.	Average Ratio of Diarrhœan Mortality at Ages 5 and upwards to that at Ages under 5 Years, during the Period 1886–92.
1886	25,631	257	9·47		157,862	25	0·16		to 59	
1887	23,296	193	7·03		161,077	24	0·15		1 to 51	
1888	25,993	70	2·74		164,859	16	0·10		1 to 27	
1889	25,833	215	8·32	6·38	167,707	19	0·11	0·11	1 to 76	1 to 58
1890	26,106	169	6·47		171,123	14	0·08		1 to 81	
1891	26,374	109	4·13		174,599	13	0·07		1 to 59	
1892	26,649	161	6·04		178,101	16	0·09		1 to 67	
1893	26,938	447	16·59		181,771	49	0·27		1 to 61	

In addition to consideration of age distribution of deaths ascribed to choleraic disease and to "diarrhœa" respectively, regard was had to the incidence on certain age-groups of known *sickness* caused by each of these maladies.

To the results of inquiry made in this sense much importance was not attached, partly because of the limited duration of the period during which diarrhœal sickness was notified, with consequent incompleteness of knowledge as regards the remainder of the year, and partly because of the want of definite data as to age-distribution of summer diarrhœa in this country, wherewith the Hull figures might be contrasted. The general character, however, of the Hull attack rates from the two diseases referred to was not such as to afford evidence that "diarrhœa" in Hull in 1893 was of different sort from that seasonally prevalent every year in many parts of this country.

It should however be borne in mind that, while the facts quoted as regards age-distribution of diarrhœal sickness as well as those relating to deaths attributed to this cause at different age-groups would seem to be incompatible with large share of the Hull "diarrhœa" in 1893 having been in reality due to cholera, yet they cannot be regarded as excluding the possibility that some smaller portion of the mortality from the former disease may have been actually due to the latter in unrecognised form. Furthermore, if reason should yet appear for hesitancy to

accept the commonly received view that age-incidence of mortality from diarrhœa is dissimilar from that of cholera mortality, it would result that there is nothing in the facts observed at Hull which is inconsistent with the view that even large part of the "diarrhœa" in that borough in 1893 may have been due to cholera.

Before proceeding further to consider choleraic disease and diarrhœa in Hull in 1893, there is need to refer to a fact which came to my knowledge in the course of my investigations, and which is worthy of attention in connection with the prevalence of choleraic disease. I allude to the circumstance that there was in Hull in 1893 an unusually large amount of enteric fever.

Enteric Fever in Hull in 1893.

In Hull during 1893, 671 cases of enteric fever were notified to the Sanitary Authority as having occurred in the borough; and to this cause were attributed 90 deaths in the course of the year. In 1893, therefore, 32 out of every 10,000 persons living in Hull were attacked by enteric fever, while rather more than 4 out of every 10,000 persons died of this disease. The following figures afford means of contrasting these rates with corresponding mean annual rates for certain groups of towns, and for Hull itself, in other years.

Sickness	*Hull:* sickness rate from enteric fever per 10,000 of population in 1893 - - - -	32
	41 *Notification towns:* sickness from enteric fever per 10,000 of population in 5 years, 1883–87 -	14
Mortality	*Hull:* death-rate from enteric fever per 1,000 population in 1893 - - - -	0·43
	Hull: death-rate from "fever"* per 1,000 population in the years 1882–91 - - -	0·26
	Twenty-eight large towns: death-rate from "fever"* per 1,000 population in 10 years 1882–91 -	0·25

From these figures it appears not only that there was in Hull in 1893 a considerably greater amount of enteric fever than is usual in that borough, but also that the attack-rate and the death-rate there from this cause were markedly greater than has obtained in the groups of towns.

Reverting now to choleraic illness and to diarrhœa in Hull in 1893, it becomes of interest to inquire what relationships, if any, obtained between these diseases on the one hand, and between them and enteric fever on the other hand, as regards their distribution in *time* and also as regards their distribution in *area*.

Distribution in TIME of Choleraic Disease, Diarrhœa, and Enteric Fever in Hull in 1893.

The following table (Table VII.) and the chart † accompanying this report afford means of comparing the distribution in time of the above-mentioned diseases in Hull in 1893. In this table are given week by week the *deaths* ascribed to choleraic disease and to diarrhœa respectively throughout the whole year; the ascertained *attacks* of choleraic disease during the period August 24th to October 12th; and *attacks* of enteric fever notified to the Sanitary Authority throughout the whole year. Here again, however, must be borne in mind the probably incomplete record of attacks by choleraic disease during the period August 24th to September 6th.

* "Fever" includes, in addition to enteric fever, typhus and simple or ill-defined forms of continued fever.

† The chart does not deal with the whole year but only with those months during which one or another of the diseases recorded was notably prevalent.

Table VII.

Showing Week by Week for 1893 the Number of Persons ascertained to have been attacked by Choleraic Disease and by Enteric Fever in Hull; as well as the Deaths in each Week registered as due to Choleraic Disease and to Diarrhœa in the Borough.

Weekly Periods, 1893.	No. of Persons attacked by Choleraic Disease.	No. of Deaths from Choleraic Disease.	No. of Diarrhœa Deaths.	No. of Persons attacked by Enteric Fever.
Week ending January 7		—	—	5
,, ,, 14		—	—	2
,, ,, 21		—	1	5
,, ,, 28		—	—	4
,, February 4		—	—	1
,, ,, 11		—	—	—
,, ,, 18		—	2	2
,, ,, 25		—	—	—
,, March 4		—	1	3
,, ,, 11		—	—	3
,, ,, 18		—	—	2
,, ,, 25		—	—	1
,, April 1		—	—	5
,, ,, 8		—	1	1
,, ,, 15		—	—	—
,, ,, 22		—	—	—
,, ,, 29		—	—	2
,, May 6		—	—	2
,, ,, 13		—	1	3
,, ,, 20		—	—	3
,, ,, 27		—	1	3
,, June 3		—	—	3
,, ,, 10		—	—	6
,, ,, 17		—	2	1
,, ,, 24		—	5	1
,, July 1		—	7	4
,, ,, 8		—	17	6
,, ,, 15		—	27	4
,, ,, 22		—	48	7
,, ,, 29		—	27	8
,, August 5		—	38	9
,, ,, 12		—	23	8
,, ,, 19		—	31	16
,, ,, 26	1	1	46	17
,, September 2	1	1	52	27
,, ,, 9	78	6	39	56
,, ,, 16	42	2	36	59
,, ,, 23	26	2	24	69
,, ,, 30	15	4	22	57
,, October 7	4	—	5	41
,, ,, 14	2	1	6	46
,, ,, 21		—	3	35
,, ,, 28		—	—	43
,, November 4		—	1	25
,, ,, 11		—	2	25
,, ,, 18		—	1	15
,, ,, 25		—	—	11
,, December 2		—	2	10
,, ,, 9		—	3	13
,, ,, 16		—	1	6
,, ,, 23		—	1	8
,, ,, 30		—	—	4
Totals - -	169	17	496	671

Consideration of Table VII. and the corresponding chart tends to the conclusion that cholera in Hull attained its maximum about the time when fatal diarrhœa, having reached its highest point, had already begun to decline. There was, it will be seen, approximate coincidence of maximum cholera with maximum enteric fever. The decline, however, of enteric fever was certainly slower than that of cholera; indeed there was still a considerable amount of the former in early November, whereas by the end of September the latter had almost disappeared.

A point not devoid of interest is the double peak (*see* chart) of the diarrhœa curve, the first occurring in the month of July, the second in late August. In this respect the Hull diarrhœa curve differs from that of most of the 33 large towns in the third quarter of 1893. Thus in 21 of these towns deaths from diarrhœa attained their highest point in July; and in other four this maximum was reached in early August. To this point I shall again make reference when I come to consider the conditions under which cholera maintained itself in Hull.

Distribution in AREA of Choleraic Disease, Diarrhœa, and Enteric Fever in Hull in 1893.

Table VIII. affords means of contrasting the extent to which various parts of Hull were invaded by choleraic disease, diarrhœa, and enteric fever respectively. It denotes for each of the registration sub-districts comprised in the borough:—the number of known attacks of choleraic disease during the period August 24th to October 12th; the diarrhœa attacks during the period September 7th to October 12th; and the enteric fever cases during the whole year.

Table VIII.

Showing for each Registration Sub-District and for the whole Borough of Hull the Number of Persons ascertained to have been attacked by Choleraic Disease and Diarrhœa in certain Weeks of 1893, as well as the Number of Enteric Fever Cases notified during the whole year; together with the Attack Rate from these causes per 1,000 Population in each instance.

Registration Sub-District.	Acreage.	Population.	Cholera and Choleraic Diarrhœa, Aug. 24 to Oct 12.		Diarrhœa, Sept. 7 to Oct. 12.		Enteric Fever during the whole Year.	
			No. of Attacks.	Attack Rate per 1,000 Population.	No. of Attacks.	Attack Rate per 1,000 Population.	No. of Attacks.	Attack Rate per 1,000 Population.
Drypool	1,561	32,305	22	0·7	69	2·1	72	2·2
Sutton	269	12,765	6	0·5	13	1·0	32	2·5
East Sculcoates	250	13,661	8	0·6	17	1·2	97	7·1
West Sculcoates	487	42,364	51	1·2	56	1·3	166	3·9
Humber	61	5,566	3	0·5	11	1·9	12	2·2
St. Mary	53	3,168	1	0·3	14	4·4	7	2·2
Myton	940	70,699	67	0·9	176	2·5	226	3·2
Newington	1,340	20,177	8	0·4	30	1·5	41	2·0
Newland	1,130	6,730	3	0·4	8	1·2	7	1·0
Stoneferry	525	963	—	—	2	2·1	11	11·5
Marfleet	1,285	251	—	—	—	—	—	—
Borough of Hull	7,901	208,639*	169	0·8	396	1·9	671	3·2

* These figures, which are obtained from local sources, differ slightly from those of the borough population as estimated by the Registrar-General, referred to in other parts of this Report.

From this table it will be seen that:—

1.—The *choleraic* attack-rate for the whole borough from August 24th to October 12th, which was 0·8 per thousand persons living, was exceeded in the registration sub-districts of West Sculcoates and Myton, where it was 1·2 and 0·9 respectively.

2.—The *diarrhœa* attack-rate for the whole borough from September 7th to October 12th, which was 1·9 per thousand persons living, was exceeded in the registration sub-districts of Drypool, St. Mary's, Myton, and Stoneferry, where it was 2·1, 4·4, 2·5, and 2·1 respectively.

3.—The enteric fever attack-rate for the whole borough, which was 3·2 per thousand per annum, was exceeded in the registration sub-districts of East Sculcoates, West Sculcoates, and Stoneferry, where it was 7·1, 3·9, and 11·5 respectively.

In comparing these attack-rates by the three diseases in question, the districts of Marfleet and Stoneferry may be entirely neglected by reason of the very small figures in each instance; while, for a similar though less strongly marked reason, little importance is to be attached to rates of districts so small as St. Mary's, Humber, and Newland. Of the remaining six districts, Myton and West Sculcoates stand out as exceeding the average attack-rate in the case of two out of the three diseases: Myton in reference to choleraic disease and diarrhœa, West Sculcoates as regards choleraic disease and enteric fever. As to Myton, it should be further noted that the enteric fever attack-rate, although it does not exceed, nevertheless equals the average attack-rate of the whole borough. Drypool and East Sculcoates are each in excess of average attack-rates of one disease; namely, diarrhœa in the case of Drypool and enteric fever in the case of East Sculcoates. The incidence of enteric fever in the latter district is very marked. The attack-rates in two remaining of these six districts are below the attack-rates of all three diseases for the borough. While, therefore, no districts other than Marfleet and Stoneferry have entirely escaped invasion by choleraic disease, and while none save Marfleet have been free from diarrhœa and enteric fever, the differences in amount of these diseases in the several sub-districts are of a nature to indicate that there has been at least some degree of localisation of the three maladies in question in certain parts of the borough. This view is strengthened by study of the two spot maps appended to this report. One of these maps shows the distribution of enteric fever attacks throughout the year; the other shows the distribution of cholera, choleraic diarrhœa, and diarrhœa attacks, during the period August 24th to October 12th for the first-named two diseases, and during the period September 7th to October 12th for the last-named disease. In Myton, for example, there are seen three areas especially thickly dotted in each map, and while these affected areas cannot, on comparison of the two maps, be said to correspond accurately, they nevertheless do so approximately. In West and East Sculcoates the spots in the two maps correspond in a general way; while in Drypool and Sutton there is also resemblance in their manner of distribution. Reference to these facts will again be made by me in dealing with the question of maintenance of cholera in Hull.

Causation of Choleraic Disease in Hull in 1893.

In searching for the cause of cholera and choleraic diarrhœa in Hull in 1893, attention was directed in the first instance towards the manner

in which cholera may have been introduced into the district; and, secondly, consideration was given to the way or ways in which cholera, after introduction into the borough, had been maintained there.

Manner of introduction of Cholera into Hull.

The first recognised case of cholera in Hull occurred, it will be remembered, on August 24th. Into the previous history and the actions of this boy during several days immediately antecedent to his illness minute inquiry was made, with the view of ascertaining in what way he might have been exposed to infection by cholera. Careful investigation failed to reveal that he had been in communication direct or indirect with the man described on p. 1 as having, on August 16th, been attacked by a malady presenting choleraic symptoms, or with any other person suffering from illness which could be regarded as of a choleraic nature. Further, it did not appear that he had partaken of any article of food which there was sufficient ground for considering a possible medium of choleraic infection. But I ascertained that it had been the practice of the deceased (as of other boys) to bathe in one of the land drains which I describe at a later stage of this report as intersecting Hull. The particular land drain in which the deceased was wont to bathe is that known locally as the "Sutton Drain," more properly described as the Holderness high level drain. Into it, up to and at the time of the illness of deceased, flowed a considerable amount of sewage from certain houses in Hull as well as from a few in the Sculcoates Rural District beyond the borough. In addition the land adjacent to it in the country district is liable to be freely manured with night soil; and, moreover, it is stated to be the custom of the occupants of numerous houses on the banks of that part of the drain which is within the borough to throw into it liquid refuse as well as garbage.

It appears, from statements made to me by companions of deceased, that the latter while bathing in the drain about 1 p.m. on Wednesday, August 23rd, swallowed a mouthful of the water, at a time when this was exceptionally foul by reason of the bathers having stirred up black mud from its bottom. Deceased immediately came out of the water and commented on the unpleasant taste of that which he had swallowed. It will be remembered that his illness commenced next morning, August 24th, at 5 a.m. and terminated fatally the same day at 2.40 p.m. Of six companions of the deceased who had along with him bathed in the drain on August 23rd, and who had also swallowed water, I ascertained that three suffered from diarrhœa within a period ranging from 12 to 18 hours afterwards. Of the remaining three one vomited immediately after swallowing some of the water, and experienced no subsequent ill-effects; a second suffered from nausea for about an hour after swallowing the water; and the third displayed no symptoms of illness consequent on swallowing the water unless a headache which he suffered from during school time that afternoon may be attributed to this cause.

With the view of ascertaining if possible whether the Sutton drain water contained the contagium of cholera I collected and forwarded two samples thereof to Dr. Klein for bacterioscopic examination. In one of these samples Dr. Klein ascertained the presence of a bacillus which presented all the appearances and gave all the reactions of Koch's comma bacillus. It appeared, therefore, probable that the boy who was attacked and died on August 24th had contracted cholera from swallowing water in the Sutton drain, to which in some way the infectious material of that disease had gained access. It therefore became of interest to

ascertain, if possible, in what way the water of the drain in question might have become infected. To this end careful inquiry was made at all houses from which sewage passed into the Sutton drain, and at all houses situated on its banks—without as well as within the borough of Hull,—with a view to ascertaining whether diarrhœal sickness of a suspicious character had been known to exist among their inmates during 1893 prior to August 23rd. In several of these houses diarrhœa was found to have prevailed anterior to the date mentioned, but in no instance was a history obtained such as would afford reasonable ground for suspecting one of these diarrhœa cases to have been in reality a case of cholera.

Efforts to trace further the source of infection of the case of August 24th having failed, I sought next to ascertain whether the person attacked on August 16th by sickness bearing a suspicious resemblance to choleraic disease had been exposed to infection of the sort.* This person who, it will be remembered, resided in a common lodging-house, was a labourer engaged in deal carrying at one of the Hull docks. He had been out of work since August 4th, but nevertheless frequented the docks during the days between August 4th and 16th. There is, however, no definite knowledge of his having held communication with any person from a cholera-invaded place or with anyone known to have been suffering from illness of a suspicious character. In like manner there is no history of occurrence of suspicious illness in the common lodging-house at which he resided and of which he had been an occupant for four months prior to his attack. If then the illness from which this person suffered was of a choleraic nature, the manner in which he contracted the disease remains uncertain.

Inquiry, therefore, with the view of definitely ascertaining how cholera was introduced into Hull gave negative results. Failure of this sort, however, need not be matter for surprise. For cholera was in 1892 epidemic in Hamburg, with which town Hull is in constant communication, and was also to a less degree prevalent elsewhere abroad; while in 1893 cholera is known to have existed not only on the Continent of Europe but also during the early autumn at Grimsby, a town not far distant from Hull, with which it has considerable traffic. As matter of fact in the autumn of 1892 three persons suffering from cholera are known to have arrived in Hull. One of these was on board a vessel from Cronstadt and St. Petersburg; the other two were on vessels from Hamburg. All these persons were detained by the Port Sanitary Authority, and were isolated at the "Garrison" Hospital of the Hull Urban Sanitary Authority. (The Port Sanitary Authority had not then, as they now have, a floating hospital near Hull in the River Humber.) The excreta of these cases of 1892 were cremated and their belongings were disinfected. Slop-waters from the Garrison Hospital discharge directly into the Humber (see my account of sewerage and drainage at a later stage of this report). Two of the patients recovered, the third died and was interred in the Hedon Road cemetery. Watch was kept over the health of all persons on board the vessels which had brought cholera cases to Hull in 1892, and these vessels, with all articles thereon that might have been exposed to infection, were duly cleansed and disinfected. In 1893, prior to the occurrence of the case of August 16th, already described by me, no person suffering from choleraic disease is known to have arrived in Hull.

* As has been said, the most careful inquiry failed to reveal that there had been any communication, direct or indirect, between this person and the boy who died on August 24th.

Such information, therefore, as is forthcoming does not tend to clear up the obscurity of origin of cholera in Hull in 1893. It is open to anyone to contend that some person or persons suffering from cholera, not recognised as such, arrived in either 1892 or 1893 in Hull and deposited there the infection of the disease. Persons in seeming good health, but who, after landing, develop slight and unrecognised cholera, would not, of course, be detained by the Port Sanitary Authority, nor would they later on be reported to the Urban Sanitary Authority as suffering from cholera. That in this way cholera may have gained access to and become established in Hull is not to be denied; but I am not in possession of any data definitely supporting this hypothesis.

Subsequent Maintenance of Cholera in Hull.

Propagation by Personal Communication.—In so very few instances was personal communication, direct or indirect, found to have taken place between occupants of invaded households and persons who had been suffering from disease of a choleraic nature, that no adequate explanation could in this way be found for the maintenance of cholera in Hull subsequent to the date at which it is ascertained to have made its appearance there. In the absence therefore of satisfactory explanation of this sort attention was directed towards conditions one or other of which might have tended to prolong the existence of cholera when it had gained admittance to the district. In this way were passed in review the general sanitary circumstances, the sewerage and drainage arrangements, the disposal and removal of excreta and refuse, the milk supply, the water supply, and the sanitary administration of the borough; and with result as follows.

General Sanitary Circumstances.—The district comprised by the borough of Kingston-upon-Hull (population estimated in the middle of 1893 at 208,639) covers an area 7,901 acres in extent. It occupies an alluvial flat of which the surface levels range from 6½ to 17 feet above Ordnance Datum, averaging 8 feet above Datum. In great part the district is below high water level of ordinary spring tides (12 feet above O.D.). Geologically, Hull stands upon deposits filling up a hollow basin in the Chalk; the latter lying at a depth varying from 35 to 100 feet below the present ground-surface. The superficial soil consists of several feet of pure brick-clay which merges, from above downwards, into silts of differing density. Both clay and silt are wet and retentive of moisture, but the underground water is rarely found at a depth of less than 20 feet from the surface. The town, which lies on the north bank of the River Humber, is intersected by the River Hull as well as by the great agricultural drains of Holderness to the east of the River Hull, and of Skidby, Cottingham, and Beverley to the west of it. These drains, which discharge into the Hull and the Humber through tidal gates, cut through the upper clay into the silt, but they are stated to be watertight and retentive of their contents. Roadways are generally well paved and scavenged. House yards, courtyards, alleys, and passages are for the most part paved with stone flags, bricks, or cement, and kept in cleanly condition. The houses inhabited by the poorer classes are usually two-storey brick cottages each occupied by one family only. The condition of these dwellings on the whole is fair, although exceptions to the rule are not wanting. In many of the older parts of Hull, however, houses are huddled together without sufficient regard for the amount of air space that should surround dwellings.

Sewerage and Drainage.—There are in Hull three areas with separate sewerage systems and distinct sewage outfalls. One of these occupies the whole of that part of the borough which lies to the east of the River Hull, with the exception of a few outlying houses which drain into cesspools; the other two occupy the remainder of the borough which lies to the west of the River Hull. Of the two latter areas one is small and is formed by an island enclosed by the Humber on the south, the "old harbour" (into which the River Hull discharges) on the east, and the Queen's, Prince's, and Humber Docks on the west. The other of these two areas comprises the whole of the borough lying to the west of the River Hull, except the island just described. To the first of these three areas I shall allude as the "eastern," to the second as the "central," and to the third as the "western" sewerage area.* In all three areas main sewers are constructed of brick and are oval in shape; subsidiary sewers are stoneware pipes. The fall of sewers in the borough is necessarily small by reason of the flatness of the district. The sewers are, however, said to be regularly flushed, and are for the most part fairly well ventilated, although in this latter respect there is room for improvement. The sewage of the "western" area has continuous outfall into the Humber, into which it is delivered by means of pumps. At the time of cholera prevalence there was no pumping station for the "central" or for the "eastern"† area, of which the sewage accordingly was tide-locked during considerable part of the 24 hours. The sewage from all three areas is discharged in a crude state into the Humber. House drainage in Hull is effected by means of sanitary pipes, which are, however, for the most part not properly disconnected from sewers or sufficiently ventilated. Yard and sink-pipe gullies are properly trapped, and interiors of houses are in almost all instances disconnected from drains.

Disposal and Removal of Excreta and Refuse.—Hull is in great part a midden-privy town; the privy generally in use being of small size, and having its bottom at or slightly below ground level. These midden-privies, though doubtless an improvement on the ancient midden that still prevails in many northern towns, fall short in a sanitary sense of the fixed privy receptacles that are permissible under byelaws based on the Board's model. Not infrequently the Hull privies are found to smell offensively, and such of them as cannot be cleansed without purveyance of their contents through the dwelling are altogether objectionable. In the better class parts of the town, however, there are many water-closets, and recently these have been here and there introduced into the lower class neighbourhoods also. House refuse is added to the midden privy contents where this method of excrement disposal is in use; and it is deposited in separate receptacles, for the most part movable, where water-closets are employed. Scavenging of excreta and refuse, which is carried out by contractors, leaves room for improvement, though the contents of the receptacles containing excrement and refuse are stated to be removed not less seldom than once a week. The contents of privies are disposed of as manure to farmers, while dry refuse is burnt in a destructor erected by the Sanitary Authority in 1881. In this destructor are also burnt contents of pails

* The sewage of a small island which lies between the central and the eastern sewerage areas, discharges directly into the Humber and is not connected with any of the three sewerage systems above described. On it stand the Garrison Hospital, one inhabited house, cattle sheds, and sundry wood yards.

† A temporary pumping station has since been erected (November 1893) for the eastern district.

removed from houses invaded by enteric fever; a precaution extended in part of 1893 to houses invaded by disease of a choleraic character or by diarrhœa.

From the account I have given of the general sanitary circumstances, the sewerage and drainage arrangements, and the methods of disposal and removal of excreta and house refuse, it will be seen that in all these respects the state of Hull leaves a good deal to be desired. It appears that the town is low-lying and situated on soil of a sort not the most conducive to conditions encouraging health. Under these circumstances unwholesome conditions of the kind noted by me, namely, flatness of sewers, with occasionally defective ventilation of some of them, insufficient disconnection of house-drains from sewers, shortcomings as regards disposal and removal of excrement and refuse, and huddling together of houses of the poorer class, become the more dangerous. It is true that no evidence appeared which pointed to sewerage or to drainage arrangements as directly related to cholera maintenance; nor did I find reason to directly attribute persistence of the disease to methods of disposal and removal of excreta and refuse. Nor were all houses invaded by cholera those of the poorer class. But it is a noteworthy fact that the majority of invaded houses were in those neighbourhoods where poorer class dwellings are huddled together, and where conditions of cleanliness and free access of light and air are at a minimum. These facts tend to encourage a thesis that the cholera contagium, having gained access in some way to the soil on which the borough stands, found there a suitable medium for maintaining itself, and was thus enabled to select for subsequent attack inhabitants of the town living under the most unwholesome conditions. A similar preference for a particular class of person and locality would appear to have been exhibited by both diarrhœa and enteric fever in Hull in 1893, the areas especially affected by these latter diseases having been approximately the same as those invaded by choleraic disease. The double peak in the Hull diarrhœa curve in 1893, considered already under the heading of "distribution in time" of these three diseases, may also be regarded as pointing to a part played by the above unwholesome conditions in maintaining cholera in the borough. For the unusual prolongation and the late severity following on the earlier prevalence, also considerable, of diarrhœa in Hull, as contrasted with most other towns, would seem to indicate that in this town the contagium of this disease found itself in circumstances especially suited to its development. However this may be, diarrhœa in Hull exhibited tendency to especial manifestation in localities exceptionally affected by choleraic disease and by enteric fever. It is, accordingly, probable that in the maintenance of cholera as well as of diarrhœa and enteric fever in Hull in 1893 the "general sanitary circumstances" of the place directly, and conditions of sewerage and of excrement and refuse disposal and removal indirectly, played at least a not unimportant part.

Milk Supply.—The source of milk supply was ascertained in the case of all houses invaded by cholera, choleraic diarrhœa, diarrhœa, or enteric fever. From the information thus obtained, however, nothing appeared tending to cast on any particular source of milk supply suspicion of its having acted as a medium for the transmission of any of these diseases in the borough.

Water Supply.—The water supply to the borough is obtained from two sources, of which one is situated at Springhead and the other at Cottingham. The former place is some 4 miles to the west, and the latter about 5 miles to the north-west of Hull. The supply is constant

and averages 30 gallons per head per day for all purposes. The water of both sources is obtained from wells and borings in the chalk. The Springhead water is from a shaft, 22 feet in diameter and 72 feet deep, lined in its upper half with iron tubing. Two adits, one at a depth of 60 feet, the other at a depth of 72 feet from the surface, have been driven from the shaft in an easterly and in a westerly direction respectively. The eastern adit is 1,334 yards in length, and in connexion with it is a borehole 340 feet deep. The western adit is 1,716 yards in length, and in connexion with it are four boreholes varying from 300 feet to 400 feet in depth. Surface water is not known to be admitted to the Springhead supply; but the adits are not far distant from certain large cesspools, attached to houses in the neighbourhood and sunk in the chalk. The Cottingham source consists of three shafts each 80 feet in depth and lined throughout with iron cylinders. In connexion with these is an adit, driven in a northerly direction for a distance of 500 feet, and from which proceed three boreholes to a further depth of 200 feet. It is important, however, to note that at the surface of the chalk (40 feet from the surface of the ground) the iron lining of the shafts is freely perforated so as to allow of entrance into the wells of water on the surface of the chalk. Of this water there is a large quantity; and a rainstorm within a few hours raises largely the quantity of water obtained from the wells. Surface water therefore gains access to this supply and that, sometimes, to a very considerable extent.

There is no storage accommodation for water derived from either of these sources. The water pumped from each source passes directly, and without filtration, into mains, and these waters are mixed before distribution to the borough.

It is manifest, therefore, that neither of the sources is such as to give security that the water therefrom will at all times be absolutely pure and entirely free from danger to the health of consumers. At the same time the evidence I have given in the course of this report as regards manner of prevalence of choleraic disease, as well as of diarrhœa and enteric fever, in Hull in 1893, is not such as to afford ground for suspecting the water-supply of the borough as having played any appreciable part in the maintenance of any of these diseases in the district.

Sanitary Administration.—Before proceeding to describe the steps that were taken by the Sanitary Authority with a view to dealing with the outbreak of cholera in Hull, I summarise, as briefly as may be, the scheme of sanitary organisation of the borough for ordinary purposes.

The chief sanitary officer of Hull is the Medical Officer of Health, who has under his control the following staff:—

1 Deputy-Medical Officer of Health (who is engaged in practice).
1 Inspector of Nuisances.
4 Assistant Inspectors of Nuisances.
11 "sanitary officers."
5 Inspectors for special purposes (such as inspection of food, offensive trades, &c.).
16 drain-flushers.
16 whitewashers.
4 disinfectant distributors.
5 clerks.

The town, for purposes of sanitary administration, is divided into four districts. Each district is in charge of an assistant inspector, who has two or more "sanitary officers" under him. The assistant inspectors are

responsible to the Inspector of Nuisances, who is in turn responsible to the Medical Officer of Health. The staff of flushers and whitewashers quoted in the list given is made use of in cleansing the poorer-class neighbourhoods. It is the duty of these officers to periodically flush out subsidiary drains and to whitewash the walls of courts, yards, and entries in certain districts allotted to them. It is also part of their duty to take the same steps in courts or yards where infectious disease is known to have occurred. The Sanitary Authority disinfect free of charge houses that have been invaded by infectious disease, and also all articles that have been exposed to infection. For the latter purpose high-pressure steam is employed. They have two hospitals for infectious diseases, one of which is a good building, constructed of brick, with accommodation for 150 patients; the other a wood and brick structure capable of accommodating 50 patients. In connexion with both hospitals there is spare ground sufficient for the erection of tents in case of need.

On the appearance of choleraic disease in the borough in 1893 the following steps were taken by the Sanitary Authority.

On September 5th circulars were issued to all medical men practising in Hull requesting them to notify to the Medical Officer of Health all cases of choleraic diarrhœa* that might come under their care, and intimating that the usual fee (2*s.* 6*d.*) would be paid for each notification. On the same date another circular was issued to medical practitioners stating that the Sanitary Authority would supply free of charge disinfectants to any person provided with an order (of which a number were enclosed for use). Stations (shown by yellow crosses on Map I.) were opened in various parts of Hull for distribution of disinfectants and of diarrhœa mixture. Placards were posted throughout the town, headed "Urgent Sanitary Precautions," and treating briefly of simple precautions as regards food and drink and of need for at once seeking medical advice in the event of attack by diarrhœa.

On September 4th a medical man was temporarily appointed to assist the Medical Officer of Health. To this work he was to give his whole time. He received a salary of 5*l.* 5*s.* per week with board and lodging. His engagement terminated on October 31st.

Each house notified as invaded by cholera, choleraic diarrhœa, or diarrhœa was forthwith visited by an officer of the Sanitary Authority. Cases of cholera or choleraic diarrhœa were taken to hospital if in a fit state for removal, and if this step were considered desirable. If the person attacked was not thus removed instructions, printed as well as verbal, were given to members of the invaded household regarding necessary sanitary precautions; and, after cleansing and disinfection of the privy and removal of its contents for cremation, a specially constructed pail was supplied by the Sanitary Authority to receive the bowel discharges. Until the medical attendant certified that infection had ceased this pail was removed daily by the Sanitary Authority and its contents burned in the Corporation destructor. These pails were also supplied to houses invaded by ordinary diarrhœa. Disinfection and cleansing of invaded houses, of infected articles, flushing of subsidiary drains, and whitewashing of courts, yards, and passages were resorted to in all cases of choleraic disease. Drains of houses known to be invaded by diarrhœa were in all cases flushed and disinfectants also

* On July 29th, the Sanitary Authority by circular requested medical practitioners to notify severe cases of diarrhœa to the Medical Officer of Health; but no fee was offered, and the request was not complied with.

supplied to the occupants gratis. Efforts were in all cases made to ascertain the source of infection; and members of households invaded by choleraic disease, as also persons who had recently had communication with these or who resided in their near neighbourhood, were as far as possible kept under observation for not less than one week in order that illness on the part of these persons might as soon as possible become known to the Sanitary Authority.

The arrangements, both general and special, which I have just described were carried out by the officers of the Sanitary Authority during the period of cholera prevalence with promptness and thoroughness in every instance that came under my observation. The sanitary organisation of Hull is good, and stood well the strain put upon it by the outbreak of choleraic disease in the borough. The weakest point in the administrative arrangements consists in the want of an Assistant Medical Officer to give his whole time to the work of aiding the Medical Officer of Health, who is also surgeon to the borough police, medical superintendent of both infectious diseases hospitals (where there is no resident medical officer), and Medical Officer of Health to the Port of Hull and Goole. This insufficiency of medical staff, which requires to be permanently remedied, was temporarily met by the appointment of such an assistant during the period of cholera prevalence.

Conclusion.

From the foregoing account it does not appear that disease of the nature of cholera was prevalent to any large extent in Hull in 1893. Its continued maintenance there, however, for several weeks, and the fact that it was accompanied by unusual amount of diarrhœa and of enteric fever, are circumstances that merit the serious attention of the Sanitary Authority. What evidence is to hand regarding the reason for this maintenance of cholera and unusual prevalence of diarrhœa and enteric fever, tends to point to their having been favoured by the existence of certain unwholesome conditions in connexion with the general sanitary circumstances, the sewerage and drainage arrangements, and the methods of removal and disposal of excrement and refuse in the town. To the amelioration of such of these conditions as are capable of improvement the Sanitary Authority should direct their efforts. Nor should they neglect careful inquiry into the nature of their water-supply, with the view of taking such steps as may ensure to the inhabitants of the district in their charge an ample supply of water uniformly of undoubted purity. Although, as I have stated, nothing in the course of my inquiry transpired tending to throw on water suspicion of its having played an appreciable part in maintenance of cholera or other disease in the borough, yet certain circumstances in connexion with the sources from which this supply is derived are of a sort to suggest that this water is less completely secured than is desirable against conditions that might possibly involve danger to the health of the inhabitants of Hull.

The steps taken by the Sanitary Authority in dealing with cholera I have already favourably commented on; and to this action of the Authority may, I think, with some justice be attributed the limited amount of this disease in their district in 1893.

Each ● *represents an attack by Cholera.*

----„-- ◉ ---------„--------- *a death from* ----„------.

----„-- ● ---------„--------- *an attack by Choleraic Diarrhoea.*

---„-- ● ---------„---------„----------„-------„---*Diarrhoea.*

----„-- ○ ---------„---------- *a Hospital.*

---„---- ✚ ---------„---------„---*Station whereat "Diarrhoea mixture" and "Disinfectants" were obtainable.*

----„---- △ *represents a Cholera burying ground.*

---„--- ■ ---------„--------- *a Mortuary.*

The distribution of Cholera and Choleraic Diarrhoea is shown for the period August 24th to October 12th (inclusive:) the distribution of Diarrhoea is shown for the period September 7th to October 12th inclusive.)

MAP I.

MAP OF THE SEVERAL REGISTRATION SUB-DISTRICTS OF HULL.

Showing the distribution of Cholera, Choleraic Diarrhoea and Diarrhoea in the borough in certain weeks of 1893; and indicating the Hospitals, Mortuaries, and Cholera Burying Grounds, as also the Depôts whereat "Diarrhoea Mixture" and "Disinfectants" were obtainable during the Cholera Season.

6480.9.94.

NEWLAND
NEWLAND PARK
WATER WORKS
PEARSON PARK
WEST SUTTON
SUTTON
CEMETERY
HYMERS COLLEGE
HULL TOWN CRICKET CLUB
WEST PARK
NEWINGTON
CEMETERY
PRINCES DOCK
DOCK OFFICE
GARRISON HOSPITAL
ALBERT DOCK
SIR WILLIAM WRIGHT'S DOCK
ST ANDREW'S DOCK
HESSLE JUNCTION
NORTH EASTERN RAILWAY
HULL & BARNSLEY RAILWAY
HULL & SELBY LINE
HULL & ENTON JUNCTION BRANCH
R I V E R
SCALE, — 3 Inc

MAP II.

MAP OF THE SEVERAL REGISTRATION SUB-DISTRICTS OF HULL;

Shewing the distribution of Enteric Fever in the borough during 1893.

Each ● represents a certified case of Enteric Fever.

One Mile

Wyman & Sons, Lᵗᵈ, Lith, 63, Carter Lane. 8480. 9. 94.

MAP SHEWING THE REGISTRATION DISTRICTS FOR BIRTHS AND DEATHS IN THE COUNTY BOROUGH OF KINGSTON-UPON-HULL. 1893

PARISH OF COTTINGHAM

PARISH OF SUTTON

PARISH OF PRESTON

PARISH OF HESSLE

NEWLAND

STONEFERRY

WEST HULL

SUTTON

MYTON

DRYPOOL

MARFLEET

NEWINGTON

ALEXANDRA DOCK

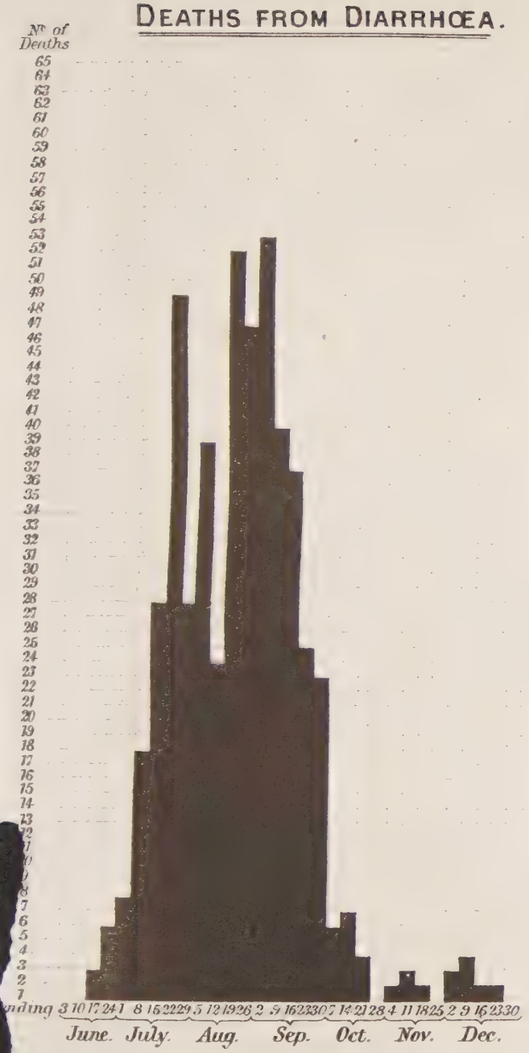
HULL, BARNSLEY & W. R. J. RLY & DOCK Co. PROPOSED EXTENSION OF WORKS

RIVER HUMBER

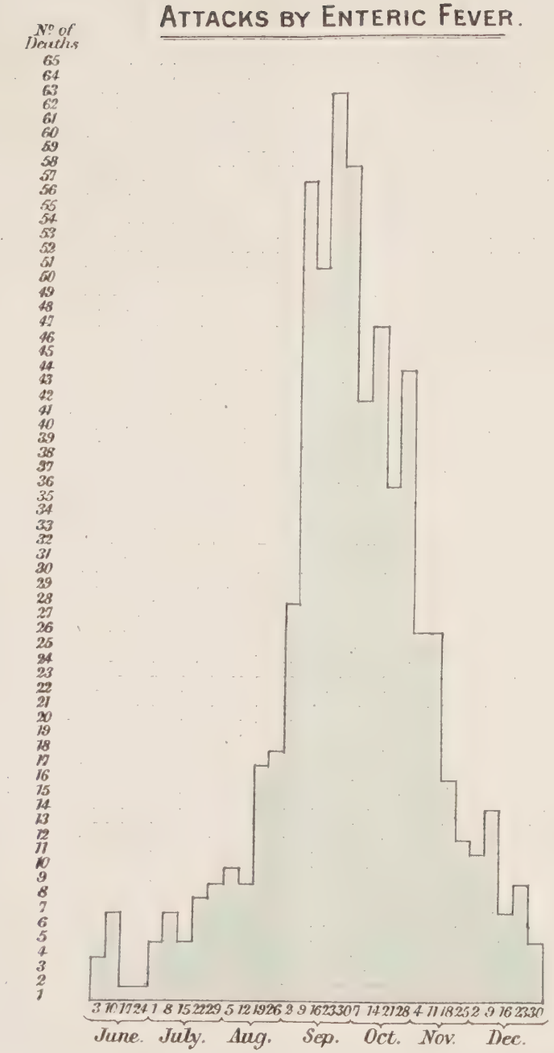
SCALE.— 6 Inches to One Mile

Wyman & Sons, Lith. 63 Ca

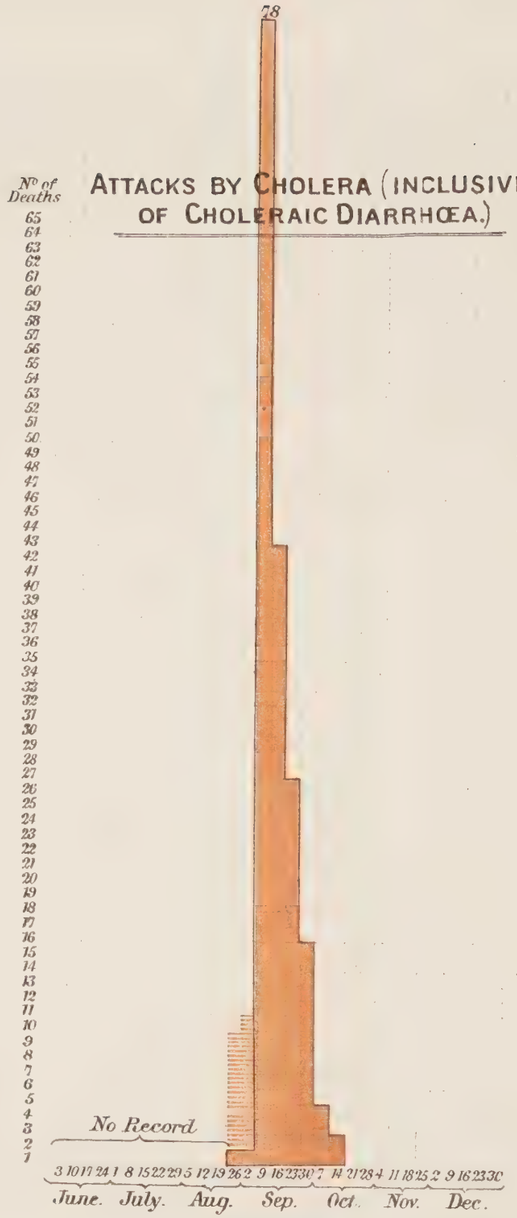
Deaths from Diarrhœa.



Attacks by Enteric Fever.



Attacks by Cholera (inclusive of Choleraic Diarrhœa.)

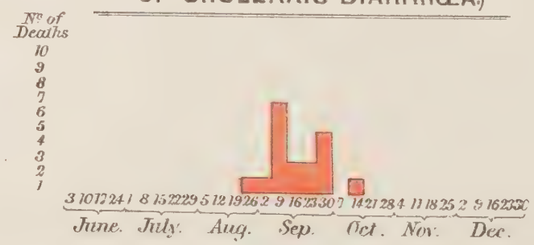


Borough of Hull.

DIAGRAM. *Showing week by week from June to December 1893, the number of deaths reffered to Cholera (inclusive of Choleraic Diarrhœa) and to Diarrhœa: and showing also in like fashion, the number of persons ascertained to have been attacked by Cholera (inclusive of Choleraic Diarrhœa) and by Enteric Fever.*

- *Represents a Death from Cholera (inclusive of Choleraic Diarrhœa.)*
- *Represents an attack by Cholera (inclusive of Choleraic Diarrhœa.)*
- *Indicates weeks wherein the number of attacks was probably considerably in excess of those recorded.*
- *Represents an attack from Enteric Fever.*
- *" a Death by Diarrhœa.*

Deaths from Cholera (inclusive of Choleraic Diarrhœa.)



Waterlow & Sons Ltd. Lith.

No. 4.

Report on Cholera in the Borough of Rotherham in 1893; by Dr. Theodore Thomson.

On September 5th, 1893, the Board received from the Medical Officer of Health of the Borough of Rotherham a telegram stating that on that day a case believed to be Asiatic cholera had occurred in his district, and that the person thus attacked had succumbed to the disease. Communication hereupon took place by telegram between the Board and the Medical Officer of Health as to steps to be taken with the view of definitely ascertaining the true nature of this person's malady; and in consequence a portion of the lower bowel (ileum) of the deceased was on the 6th September forwarded to Dr. Klein for bacterioscopic examination. As a result of Dr. Klein's investigations it appeared (7th of September) that the case was indistinguishable from true cholera; and I was accordingly instructed to proceed forthwith to Rotherham for the purpose of making inquiry into the circumstances attendant on the illness of the deceased, and to report also as regards the steps that were being taken by the Sanitary Authority with the view of preventing spread of cholera. I arrived in Rotherham on September 8th, and from inquiries made then, and subsequently, ascertained the following facts.

William B., collier, 35 years of age, residing in Tummon Street, Masbro' (in the borough of Rotherham), was in his usual health on September 4th. On the morning of September 5th he rose at 5 o'clock and had a loose motion. Afterwards he partook of breakfast as usual, and at 8 o'clock set out with a friend on a fishing expedition to a neighbouring stream. On the way he was attacked with vomiting and diarrhœa, but nevertheless continued his journey. On the banks of the stream he was seized with severe diarrhœa, vomiting and cramps, so that he had to be conveyed home in a cart. He reached home about 2 p.m., and was there seen by a medical man shortly afterwards. He was then, it is stated, in a condition of collapse, with pulse imperceptible at the wrist, extremities cold, face pinched and dark in colour. There was no further sickness or diarrhœa after he reached home; but the condition of collapse continued, and he died at 7 p.m.

Subsequently the following cases certified as cholera by their medical attendants occurred in the borough.

On September 11th: John W., Arthur Street, aged 50 years.

On October 18th: George N., Sales Yard, aged 39.

The clinical features of the first of these two cases were as follows:—Severe cramps in the abdomen and in the extremities, vomiting, frequent rice-water stools, cold and dusky skin, feeble voice, diminution of urinary secretion, pulse at wrist imperceptible. Death occurred 26 hours after seizure. The symptoms observed in the second case were severe cramps, sickness, and copious rice-water stools. In this instance recovery ensued.

App. A. No. 4.

In all, therefore, three cases certified as cholera are known to have occurred in the autumn of 1893 in the borough; and of these three two had a fatal result. There was no localisation of the disease in any particular portion of the district; the residences of these three persons were widely separate.

In addition, however, to these cases certified as cholera there occurred in Rotherham other 18 cases certified as "choleraic diarrhœa." The distribution of these in time was as follows:—

On	September	15th	were notified	4 cases.
„	„	18th	was „	1 case.
„	„	19th	were „	2 cases.
„	„	20th	„ „	2 „
„	„	24th	was „	1 case.
„	„	26th	„ „	1 „
„	October	2nd	„ „	1 „
„	„	6th	„ „	1 „
„	„	7th	„ „	1 „
„	„	9th	were „	2 cases.
„	„	14th	was „	1 case.
„	„	18th	„ „	1 „
	Total	-	-	18 cases.

As regarded two only out of these 18 persons attacked by choleraic diarrhœa was bacterioscopic examination of stools (by Dr. Sims Woodhead) resorted to; but with the result that both cases were declared indistinguishable from true cholera. These two were notified (as choleraic diarrhœa) on October 2nd and October 6th respectively. With the single exception of the case notified on October 6th, which proved fatal, all the notified cases of choleraic diarrhœa recovered. Of these 18 cases, 15 were between the ages of 25 and 60, two between the ages of 5 and 14, and one was 1 year of age. There was no exceptional incidence of this "choleraic diarrhœa" on any one part of Rotherham; the cases were, on the contrary, scattered throughout the district with tolerable equality.

In view of this cholera and "choleraic" diarrhœa in Rotherham in 1893, it becomes of interest to note also the amount of illness designated as diarrhœa which existed in the district in that year. And first as to the number of *deaths* attributed to this cause in Rotherham during the second and third quarters of 1893. Of these there were 85, a number which is in excess of the total deaths from this cause in Rotherham in any complete year during the preceding decade. The appended table (Table I.) affords means of comparing year by year the death-rates in Rotherham from diarrhœa during the period 1883–93, and also allows contrast of the Rotherham diarrhœa death-rates with those of the 28 large towns.

Table I.

Showing the Number of Deaths referred to Diarrhœa in Rotherham during each of the Ten Years 1883–92, and in the Second and Third Quarters of 1893, together with the resulting Death-rates per Thousand living in each instance. For purposes of comparison the Death-rate yearly from the same cause in 28 large Towns during the same period is added.

Year.	Rotherham.				28 Large Towns.	
					Death-rate per 1,000 from Diarrhœa.	
	Population.	No. of Deaths from Diarrhœa.	Death-rate per Annum from Diarrhœa per 1,000 living.	Diarrhœa Death-rate in Period 1883–92.	In each of the Years 1883–92.	1883–92.
1883	36,301	8	0·22		0·77	
1884	36,998	42	1·14		1·21	
1885	37,707	29	0·77		0·69	
1886	38,431	41	1·07		0·97	
1887	39,168	42	1·07		0·97	
1888	39,920	21	0·53	0·88	0·60	0·82
1889	40,685	66	1·62		0·82	
1890	41,466	40	0·96		0·77	
1891	42,261	37	0·87		0·67	
1892	43,072	22	0·51		0·70†	
Second and third quarters of 1893.	43,898	35	1·94*		1·07†	

* This is the rate per 1,000 living calculated not for the whole year, but for six months only.
† This rate is calculated on 33 large towns, not on 28 large towns, as in the remainder of the column.

From these figures it appears that during the decade 1883–92 the death-rate from diarrhœa in Rotherham was slightly in excess of the death-rate from the same cause in the 28 large towns during that period. Also it appears that the Rotherham diarrhœa death-rate exceeded the average annual rate for that town, in 1884, 1886, 1887, 1889, 1890, and again in 1893. Prior to 1893 the highest point reached by the rate was in 1889, when it was 1·62 per thousand per annum. But in 1893 the rate is seen to be considerably in excess of this, inasmuch as it is 1·94 per thousand for a period of six months only. It is true that within that period fall those portions of the year during which diarrhœa most prevails; nevertheless, the figures for the whole year will, it may safely be assumed, give a rate at least somewhat in excess of that quoted. The death-rate from diarrhœa in the country generally, however, was in the summer of 1893 above the average; and, accordingly, I append a table (Table II.), which affords means of comparing the death-rate from this cause in the borough of Rotherham with that from the same cause in the large towns and in England and Wales in the second and third quarters of 1893.

Table II.

Showing the Diarrhœa Death-rate per Thousand Persons living per annum in Rotherham, in 33 large Towns, in 67 other large Towns, and in England and Wales in the Second and Third Quarters of 1893.

Area.	Second Quarter, 1893. Diarrhœa Death-rate per 1,000 per Annum.	Third Quarter, 1893. Diarrhœa Death-rate per 1,000 per Annum.
Rotherham - - -	1·02	6·74
33 large towns - -	0·81	3·5
67 other large towns - -	0·61	3·3
England and Wales - -	0·52	2·3

From these figures it appears that both in the second and in the third quarter of 1893 the death-rate from diarrhœa in Rotherham was far higher than in the large towns or in England and Wales; indeed in the third quarter the death-rate in Rotherham was nearly twice as heavy as the mean rate of other towns. There was, therefore, not only an exceptionally heavy diarrhœa death-rate in Rotherham in 1893 as compared with its own previous records, but also as compared with the rates of the large towns and of the country generally for the second and third quarters of that year.

In the absence of returns of *cases* of diarrhœa—which is not one of the diseases scheduled by Rotherham for compulsory notification—no definite information is forthcoming as to the number of persons attacked by this malady during the whole of the period embracing the second and third quarters of 1893. But, after the appearance of cholera in the place, the Town Council of Rotherham requested the members of the medical profession practising in the borough to notify for the time being all cases of diarrhœa that they were called on to attend; and accordingly I am in this way able to give a list of the number of cases of diarrhœa that came to the knowledge of the Sanitary Authority from September 10th to October 31st. This information is supplied in the following table (Table III.):—

Table III.

Showing the Number of Cases of Diarrhœa notified in Rotherham Day by Day during the Period September 10th to October 31st, 1893.

1893.		1893.		1893.	
September 10 -	18	September 28 -	5	October 16 -	4
,, 11 -	30	,, 29 -	2	,, 17 -	1
,, 12 -	39	,, 30 -	1	,, 18 -	4
,, 13 -	10	October 1 -	0	,, 19 -	4
,, 14 -	18	,, 2 -	8	,, 20 -	3
,, 15 -	25	,, 3 -	8	,, 21 -	1
,, 16 -	15	,, 4 -	4	,, 22 -	2
,, 17 -	4	,, 5 -	3	,, 23 -	1
,, 18 -	14	,, 6 -	12	,, 24 -	7
,, 19 -	18	,, 7 -	3	,, 25 -	3
,, 20 -	25	,, 8 -	1	,, 26 -	3
,, 21 -	11	,, 9 -	4	,, 27 -	1
,, 22 -	9	,, 10 -	3	,, 28 -	0
,, 23 -	5	,, 11 -	2	,, 29 -	6
,, 24 -	1	,, 12 -	4	,, 30 -	2
,, 25 -	2	,, 13 -	3	,, 31 -	3
,, 26 -	15	,, 14 -	0		
,, 27 -	10	,, 15 -	7	Total -	402

Comparison of the figures in this table with those given on page 1 regarding "choleraic" diarrhœa, shows that the period at which the latter was most prevalent was also that at which diarrhœa cases were most numerous. Thus during the 11 days September 10th to 20th half the known cases of choleraic diarrhœa were notified, while during the same period 211 out of the 402 cases in Table III. were notified.

Notwithstanding this coincidence,— which might be thought of as lending support to a thesis that this excessive diarrhœa prevalence had had relation to the presence of cholera in the district,*—analysis of the ages of persons attacked by, or dead of, diarrhœa does not go to show that there was in Rotherham in 1893 any departure from the type of summer diarrhœa usually seen in this country. In the following table (Table IV.) the *deaths* attributed to diarrhœa in Rotherham in each of the ten years 1883–92 and in the second and third quarters of 1893 are classified according to age.

TABLE IV.

SHOWING Year by Year for the TEN YEARS 1883–92, and for the SECOND and THIRD Quarters of 1893, the NUMBER of DEATHS in ROTHERHAM attributed to DIARRHŒA, classified according to their Ages.

Year.	No. of Deaths at all Ages.	No. of Deaths of Persons over 60 Years of Age.	No. of Deaths of Persons 25–60 Years of Age.	No. of Deaths of Persons 15–25 Years of Age.	No. of Deaths of Persons 5–15 Years of Age.	No. of Deaths of Persons 1–5 Years of Age.	No. of Deaths of Persons under 1 Year of Age.
1883	8	—	—	1	—	—	7
1884	42	2	—	—	1	10	29
1885	29	3	—	—	—	6	20
1886	41	2	2	—	—	8	29
1887	42	3	2	—	—	8	29
1888	21	6	2	1	—	3	9
1889	66	2	4	—	—	12	48
1890	40	3	—	—	1	8	28
1891	37	2	—	1	—	2	32
1892	22	—	2	—	—	3	17
2nd and 3rd quarters of 1893.	85	4	—	—	—	24	57

* It should be borne in mind that the absence of definite information as to amount of diarrhœa *attacks* in Rotherham, prior to September 10th, materially limits the value of the data given in Table III.: that, indeed, diarrhœa attacks may have been more numerous prior to September 10th than any time in September or October. As matter of fact the amount of *deaths* from diarrhœa in Rotherham was greater in both July and August than in September.

App. A. No. 4.

On Cholera in Rotherham in 1893; by Dr. Theodore Thomson.

From the figures of Table IV. it will be perceived that the age distribution of diarrhœa deaths usually observed in this country was not departed from in Rotherham in the second and third quarters of 1893. As in other years deaths from this cause were most abundant under five years of age, and next at ages over 60; indeed in these two quarters of 1893 all the deaths attributed to diarrhœa in Rotherham were included within those age groups.

Inquiry was also made as regards the incidence of diarrhœa *attacks* on certain age-groups. No definite conclusions, however, were permissible on the figures when formulated; partly because of the brief period during which cases of diarrhœa were being notified, with consequent small range of facts acquired; and partly because of the absence of reliable standard data of similar sort which would afford means of comparison with the Rotherham figures. Nevertheless, it may be noted that the incidence of known diarrhœa attacks in Rotherham in 1893 was, as elsewhere, found mainly on the very young. In a general way, therefore, the age-distribution of diarrhœa attacks coincided with the age-distribution of deaths from this malady; and the balance of evidence went to indicate that in Rotherham in 1893 diarrhœa did not appreciably depart from the usual type of summer diarrhœa in this country.

Further, there was no special incidence of the diarrhœa on any particular locality, whether judged of by distribution of deaths in the second and third quarters, or by distribution of the attacks known to have occurred from September 10th to October 31st.

With reference to the question of possible parallelism in this district during 1893 of diarrhœal diseases and enteric fever, I was able, enteric fever being among the diseases notified in the borough, to obtain a statement of the cases notified from January 1st to November 15th, 1893; and with result as follows:—

January:	Number of cases of enteric fever notified	-		2
February:	"	"	"	- 3
March:	"	"	"	- 5
April:	"	"	"	- 3
May:	"	"	"	- 3
June:	"	"	"	- 4
July:	"	"	"	- 5
August:	"	"	"	- 6
September:	"	"	"	- 11
October:	"	"	"	- 13
November 1st to 15th		"	"	- 4
	Total	-	-	- 59

From these figures it is evident that although there was no exceptional prevalence of enteric fever in Rotherham in 1893, yet such as occurred was in the main coincident in time with the observed major incidence of choleraic disease. But as with choleraic disease and with diarrhœa, so also with enteric fever, there was no exceptional prevalence in any particular locality of the district.

Causation of the Choleraic Outbreak.

In searching for a cause of cholera in Rotherham, attention was in the first instance directed towards ascertaining in what way the disease might have been imported into the town. To this end careful inquiry was made into the habits and previous movements of the person

attacked on September 5th, who was the first recognised case of cholera in the borough. But investigations in this sense failed to reveal that this man had, on any occasion during several weeks preceding his attack, been out of Rotherham or its immediate neighbourhood; or that anyone other than inhabitants of the district had during that period visited his residence. Especially were inquiries made as to whether he had, during certain days antecedent to his attack, visited any place where cholera was known or suspected to exist; and as to whether he had had any sort of relation, direct or indirect, with any person who had suffered from illness bearing suspicious resemblance to cholera. But all evidence obtained on these points was of a negative character. It did not appear that he had visited any locality where choleraic disease existed; and no fact was ascertained tending to show that he had received any article by which cholera infection might possibly have been conveyed to him. It could not be discovered that he had, during days immediately preceding September 5th, partaken of any article of food or drink as to which there were grounds for suspecting that it might have served as medium of introduction of the disease.

In default of affirmative evidence on these points, search was made for cases of cholera unrecognised but existing in Rotherham prior to September 5th. These inquiries resulted in the discovery of the fact that a woman named Mary B., aged 29, residing in Clough Road, Rotherham, died on August 24th, after a few hours' illness, the symptoms of which are stated to have been abdominal pains and collapse, without sickness or diarrhœa. The medical attendant, who saw her for a few moments only and when she was already moribund, certified the death as having been "due to natural causes." This woman had, with several friends, spent the preceding day (August 23rd) at Grimsby and Cleethorpes, where cholera was then occurring. Of the party she alone had partaken of oysters on the sands at Cleethorpes. With the exception of this woman, no person was discovered to have suffered from any malady showing symptoms which there was any ground at all for attributing to cholera. The woman in question resided in a house some 500 yards distant from that inhabited by the man attacked on September 5th; but there does not appear to have been any communication between the two households.

So, too, as regards the question of subsequent maintenance of the disease in Rotherham having been due to personal communication. Negative results were obtained on inquiry into the circumstances of the cholera cases that afterwards occurred in the district. In the instance of all cases of cholera, and almost all cases of choleraic diarrhœa, there was no evidence of communication between members of invaded households.

In the absence of data pointing to maintenance of the disease by personal communication, the other conditions, which might have had concern with the cholera and choleraic diarrhœa witnessed, were in turn considered. In this way were passed in review the general sanitary circumstances of the district, the sewerage and drainage of the borough, the methods there adopted for disposal and removal of excrement and refuse, and, in addition, the milk supply and the water service.

General Sanitary Circumstances of the District.—The town of Rotherham is for the most part situated on hilly ground, draining to the Rivers Don and Rother, by which it is intersected. It lies on the Middle Coal Measures, with a considerable amount of rock approaching near to or cropping out on the surface; only alongside the Don and the Rother is found alluvial deposit. The soil immediately overlying the coal measures and rock is, to a degree greater than is the case in many other towns, exposed to fouling. This exceptional liability to fouling

is due to soakage from privy middens. The inhabited dwellings in Rotherham are mostly working class houses, and in fairly good condition. Save for the pollution of the soil by leaky privy middens, the general sanitary circumstances of Rotherham are fairly good, and are not of a nature to distinctly favour dissemination of cholera.

The Sewerage and Drainage arrangements of Rotherham are for the most part satisfactory. In large majority the sewers are well constructed, have a proper gradient, and are provided with sufficient means of ventilation. One area only, of small size, is unsewered, and drains into cesspools and into the River Don. House drains are in most instances properly constructed of sanitary pipes. The ventilation of these, however, is not infrequently insufficient. Almost all yard and sink pipe gullies are trapped, and sink pipe and other waste water pipes are, in the vast majority of cases, disconnected from the drains to which they discharge.

These facts are not such as to encourage the thesis that in Rotherham infection by sewers may have been the mode of propagation of diarrhœal disease; and in further contradiction of such an hypothesis, it is to be noted that there was no exceptional incidence of cholera, choleraic diarrhœa, or diarrhœa along the line of any particular sewer or sewers.

Excrement and Refuse Disposal and Removal.—The prevailing system of excrement and refuse disposal in Rotherham is the privy midden, the pit of which is usually sunk 2 or 3 feet below the ground level. The contents of these middens are often wet, and, from the structure of the pit, are frequently liable to percolate into and foul the surrounding soil. In the comparatively few instances where water-closets have been constructed, house refuse is stored in moveable receptacles or in brick ash-pits. Excrement and house refuse are in part disposed of to neighbouring farmers, and in part incinerated by a destructor.

In the midden system above described there is nothing, apart from the indirect effect of soil pollution by leakage from privy middens, tending to suggest connexion between this method of excrement and refuse disposal and the appearance of cholera in the district. It must not be overlooked, however, that leaky privy middens would not only pollute the ground on which the town stands, but would also, in the event of their contents becoming specifically infected by cholera excreta, transmit this contagium to the surrounding soil, where it might multiply and be in various ways conveyed throughout the district. That cholera was thus fostered in Rotherham in 1893 is not affirmed; there is no positive evidence on the subject. But this danger nevertheless exists, and should not, as I have said, be lost sight of.

The Sources of the Milk Supply to houses invaded by cholera, choleraic diarrhœa, and diarrhœa were duly ascertained, but nothing appeared tending to throw suspicion on any one supply.

The Water Service of Rotherham still remains to a great extent in the unsatisfactory condition described by me in my report on an outbreak of enteric fever in that and in two neighbouring districts in 1891. Notably the Wellgate Spring, a water of which the quality is open to the gravest suspicion, still formed, at the date of appearance of cholera in that place, part of the public water service of the borough.

Notwithstanding, however, the unsatisfactory nature of this supply as a whole, it does not appear to have been a dominant factor in the dissemination of cholera and choleraic diarrhœa in the district. For there are within the borough two areas of water supply, known as the "high level" area and the "low level" area, each with a population of something over 20,000. These two areas are supplied by water taken

from different sources, one of which is decidedly more unsatisfactory than the other; and upon the assumption that water had acted as the medium of propagation of the disease, exceptional incidence was perhaps to be looked for in that one of the two districts of which the water supply was most liable to become specifically polluted. This, however, was not the case; there was, indeed, almost equal incidence of cholera, choleraic diarrhœa, and diarrhœa in the persons inhabiting the "high level" and "low level" areas of water supply. This fact does not absolutely exclude water as a causative agent, but is undoubtedly in favour of the thesis that water had no important concern with the cholera, choleraic diarrhœa, or diarrhœa witnessed.

Action taken by the Sanitary Authority.

The Sanitary Authority displayed commendable promptitude and energy in dealing with cholera when it appeared in their district. A ward block in the Borough Hospital for Infectious Diseases was set apart for the isolation of persons attacked by cholera or choleraic diarrhœa; while another ward block was reserved for the reception of unattacked members of invaded households, in order that these persons might for a time be kept under observation. All articles that had been exposed to infection of cholera were either destroyed or disinfected by steam under pressure; invaded houses were fumigated with sulphur, their wall-papers stripped off, and the walls, floors, and woodwork of the dwelling washed with a strong solution of carbolic acid. The drains of invaded houses were tested and subsequently well flushed. In the event of unattacked inhabitants of invaded dwellings not accepting the offer of shelter at the Borough Hospital, their houses were daily visited by officers of the Sanitary Authority for some time after invasion, in order that the health of the remaining members of the household might be watched. All houses in the immediate neighbourhood of an invaded dwelling were visited by officers of the Sanitary Authority, who made inquiry as to the past and present health of the occupants. These steps were also taken with regard to members of all households in other parts of the borough who had recently visited or been visited by members of an invaded family.

In addition to the foregoing precautions, adopted consequent on the occurrence of each case of choleraic disease, the Sanitary Authority made the following arrangements. A circular was issued (on September 9th) by the Town Clerk of Rotherham to all medical men practising within the borough, requesting them to notify immediately to the Medical Officer of Health (with statement as to age of person attacked) any case of diarrhœa that might come under their attention, and intimating that the ordinary notification fee (2*s.* 6*d.*) would be paid for each diarrhœa case notified. On September 11th a further circular was issued by the Medical Officer of Health to medical practitioners enclosing a number of orders for gratuitous supply of disinfectants to be furnished by the Sanitary Authority. This second circular requested each practitioner to give these orders to such of his patients as should, in his opinion, have need for use of disinfectants. On the same date were printed placards setting forth sundry "urgent sanitary precautions" to be taken in the then emergency. These placards, to the number of 250, were posted throughout the town, but more particularly in courts and alleys. Arrangements were also made to ensure the visiting, immediately on receipt of notification, of every house invaded by cholera, choleraic diarrhœa, or diarrhœa, by an officer of the Sanitary Authority, whose duty it was to see that in every instance proper steps were taken in dealing with these diseases.

It would appear then as a result of this investigation that the cholera in Rotherham in 1893 was of but brief duration. Also that it was of small amount, unless indeed the coincident prevalence of diarrhœa, which was exceptionally great, is to be considered as in some sort related to the choleraic disease. No satisfactory evidence was obtainable as to the date at which cholera first invaded the district, or as to the manner in which it was introduced. Equally indefinite is the information respecting the means by which the disease was maintained in Rotherham subsequent to the occurrence of the first known case.

But, though the results of inquiry as to the origin and maintenance of cholera in Rotherham be indefinite and unsatisfactory, the lessons to be learned by the Sanitary Authority are not the less of importance or less deserving of serious attention. It is clear that the sanitary condition and organisation of a district must be of a high order to enable the Local Authority to successfully cope with a malady which may appear one knows not certainly whence, and be maintained one knows not certainly how. To the sanitary organisation of Rotherham I have already referred favourably; it is, indeed, susceptible of improvement, but stands less in need of reform than does the sanitary condition of the district. In two respects particularly does the latter call for unfavourable comment. One of these is the fouling of the ground on which the town stands; fouling which must of necessity be inseparable from existence within the borough of numbers of wet and leaky privy middens. The other is the unsatisfactory nature of the public water supply. That this supply should be in part derived from gathering grounds of which the conditions are such as to render possible dangerous pollution of the water thence collected, is a matter of great gravity. But that a supplementary source of this supply should be a spring, which rises in the very centre of the town and, therefore, emerges through a soil polluted by the contents of privy middens, is a condition of distinctly perilous sort. Rotherham had in 1891 actual experience of loss of life and health from fever due to specific pollution of the public water supply; but the Sanitary Authority do not appear to have profited by the lesson. In 1893 cholera made its appearance in the district, but fortunately did not, as was formerly the case with enteric fever, obtain intimate relation with the public water supply. In this there was for the Sanitary Authority matter of congratulation; but there should also be food for reflection. Let them consider seriously the responsibility for lives lost and health destroyed that will be theirs should the lesson of 1891 be repeated in 1894 with cholera in place of enteric fever as the polluting agent of the public water supply of the district confided to their charge.

No. 5.

Report upon certain certified Cases of Cholera in the Middleton Urban Sanitary District; by Dr. R. Deane Sweeting.

In conformity with instructions, I made inquiry on September 12th, 1893, with respect to certain alleged cases of cholera at Middleton, situated some 12 miles north of Manchester (population in 1891 of Middleton Urban Sanitary District, 22,162; of Middleton Parish, 11,694).

The first case to which my attention was directed was that of Mrs. G., aged 64, a publican's widow living at the "Old Hall Inn." She was said to have been subject to occasional attacks of diarrhœa, and had had slight diarrhœa more or less all the week before the onset of her fatal illness. This began at noon on September 4th with profuse purging and some griping pain. Between then and 10 p.m. her bowels were evacuated 40 times. During the night she had cramps in the legs and vomiting; her feet and hands were blue and her eyes were sunken.

The practitioner who attended her stated that when called to her at 3 a.m. on September 5th he found her with "crampy pains" in the legs and lower part of the abdomen. She had profuse diarrhœa and excessive vomiting. He saw none of the stools; but her stockings and the bed were soaked with watery inodorous evacuations. She was cold, and her temperature was sub-normal (below 95°). She spoke in a whispering raucous voice. The skin of the extremities was shrivelled and "mahogany colour." She had passed no water since the diarrhœa set in. Death ensued at noon on September 5th, and was certified as "choleraic diarrhœa, 14 hours."

The deceased served in the bar of the inn. No customers that she had served had been noticed to be ill. Now and then tramps came to the bar, but none of them had been observed to be suffering from any disease. She seldom ate cockles or mussels, and rarely partook of fish. The family had some fish a few days before her illness, but as none of the others who had shared her food had been ill, I did not inquire further into this. I could discover no kind of connexion with antecedent cholera at Hull, Grimsby, Rotherham, or any other place. Neither was there any known relation to a fatal case of "choleraic diarrhœa" which occurred in Middleton on August 27th, and which will be again mentioned. She had no unusual food during the few days preceding her attack, and what she had was shared by others who escaped.

"Old Hall" Inn consists of seven rooms, three of them belonging to the bar; the remainder were occupied by six persons. There is a narrow confined backyard attached to the house. This is badly paved and contains untrapped gullies, a foul urinal and a particularly offensive large open midden privy. The external wall of the scullery abutting on the yard is conspicuously damp, probably from old leakage of the sink pipe passing through it. Water is supplied from the public service of Middleton.

The second case was that of Mrs. C., aged 70, of 12, Chapel Street. She was a feeble, weakly woman, "hardly able to creep about," and is said to have been very subject to diarrhœa. She often suffered from this, and "the least thing set her going." On September 6th at 8 p.m. she was taken

with diarrhœa and cramps in the legs and hands. She did not complain of any pain in the stomach; but there was some vomiting, and also slight blueness of the feet and hands. At 10.30 a.m. on September 7th, she was seen by Dr. Graham (the Medical Officer of Health) and appeared to be in a state of collapse. Death occurred at 11.30 a.m., being certified as "cholera—12 hours."

I could learn of no connexion between this case and cholera in any of the already infected towns. Neither could I obtain evidence of any unwholesome food that she had eaten. In point of fact, she ate exceedingly little, usually only potato and gravy for her dinner.

It was, however, alleged that Mrs. C had contracted disease by laying out Mrs. G., and I made particular inquiry into this matter. I learnt that she was present in Mrs. G.'s house during the preparations for interment; although it is not known that she herself took any actual part in the proceedings, which were performed by two other women neighbours and the joiner who made the coffin. Mrs. C. sickened 32 hours after the death of M. G. I saw the two other women, who were in apparently perfect health; the joiner who was away on holiday at the time of my visit was also stated to be in good health.

No. 12, Chapel Street, is a four-roomed house in a terrace, occupied by four people. The sanitary circumstances, including the provision of the public water service, are good. The waste pipes are cut off, the gullies trapped; whilst the contents of the pail provided for excrement and the separate dust-bin are said to be weekly removed.

These two fatal cases had been rapidly interred. It was consequently impossible to procure for examination any of the intestine or any stools or discharges.

The third case was that of Mrs. S., aged 44, of 17, Market Street. She was attacked on Friday night, September 8th, with vomiting and purging. She had during the night some cramps in the legs, but very little pain in the belly. The vomiting ceased on Sunday morning, September 10th, the purging on Monday night, September 11th, and the patient at the time of my visit was convalescent. This patient was first seen by an unqualified assistant to a medical man in Middleton on September 9th at 5 a.m. She then had cramps in the legs, toes, hands, and lower part of the abdomen. There were excessive diarrhœa of a watery character, vomiting, and a subnormal temperature (97° 2). Her eyes were sunken, her pupils contracted, and there was cold, clammy, perspiration on her face.

The medical man himself eventually saw this case, and notified it to the Medical Officer of Health on September 11th as "cholera." At the time of my visit he was away from home on holiday, but I procured his address, and telegraphed to him to ask whether he considered the case to have been one of "English" or of "Asiatic" cholera. He replied that he regarded it to be "English cholera."

I could not ascertain in this case any relation to antecedent cholera outside Middleton. Neither could I gain information as to any unwholesome food having been partaken; she had had "chip" potatoes for supper before going to bed on Friday, and "beefsteak-pie" for dinner on Thursday; but all the other members of her family had partaken of these articles as well, and none of them had been affected.

Having ascertained that Mrs. S. had been in attendance on Mrs. C., I procured the following information as to her movements. Mrs. S. went to the house of Mrs. C., but arrived too late to be of any service, Mrs. C. being already dead, and her body laid out. I saw two other women who did lay her out, and found them quite well. But the Sanitary Inspector informed me that he saw Mrs. S. emptying the flock bed

used by Mrs. C. in Mrs. C.'s backyard, after the decease of that person. The bed was saturated with discharges, and the Inspector made her desist from emptying it. Another woman who assisted Mrs. S. to do this work did not ail at all. She also helped to wash two blankets which had been on the sick bed. She was helped in these proceedings by two women, neither of whom have suffered from cholera or any other bowel complaint. This took place on September 7th, and, as already stated, Mrs. S. sickened next day.

I saw Mrs. S. on the evening of September 12th, and twice on September 13th. She was rapidly convalescing, and had taken some solid food on the morning of the 13th. The bowels did not act during my stay in Middleton, so no stools could be procured.

No. 17, Market Street, is a four-roomed house containing six people. It forms part of a collection of ten houses which have a common back-yard. This yard is on the whole clean, though there are two coops of chickens in it. The town water is laid on. There are five privies, containing pails for the ten houses, and two dust-bins. Their contents are removed weekly. Waste pipes are cut off, and gullies are trapped.

There had been a fatal case of choleraic illness at Middleton, in July, and a second in August. The first case proved fatal on July 7th, after three days' illness, death being certified as due to "English cholera exhaustion." This case was that of a cotton spinner's wife, aged 28, a weakly woman, and very subject to diarrhœa. Her husband and four children were ailing at the time with diarrhœa, and there were six other cases (one adult, and five children), of diarrhœa in the same street, and two in an adjacent street at the same time. The medical men attending this woman spoke of her symptoms as on the whole mild; though there was considerable vomiting and purging, there were no marked cramps, no "rice water" stools, but little collapse and not much lividity. The temperature, however, was subnormal.

The second case terminated fatally on August 27th (*i.e.*, only eight days before Mrs. G.'s attack), after six days' illness, death being certified as due to "(*a*) choleraic diarrhœa; (*b*) cerebral congestion and exhaustion." This case was that of a woman 41, who was said to have been weakly and constitutionally liable to diarrhœa, from which she frequently suffered. She had violent vomiting and purging, marked cramps and abdominal pain. The motions were watery, at first light, afterwards dark, but never "rice-water." The symptoms abated, but she passed into a state of lethargic coma before death.

The husband of this woman had severe diarrhœa two days before his wife's illness, but recovered. None of their four children were attacked.

I could learn of no connexion with Hull, Grimsby, or other places in this case.

The symptoms of the attacks, fatal on September 5th and September 7th, especially of the first, were not distinguishable from those of true cholera.

Although no direct connexion could be traced between these Middleton cases and other infected places, *e.g.*, Hull and Grimsby, yet the existence of undoubted cholera at such places for several weeks antecedent to the first of them, coupled with the fact that at the end of August there had been an adult death from diarrhœal illness in Middleton, makes the history a very suspicious one.

Indeed, so far as I know, such an occurrence of fatal diarrhœal disease among adults, having such marked clinical symptoms as cramps, watery evacuations, and subnormal temperature, is in this country rarely to be found dissociated from true cholera infection.

ACT A. No. 6

Immediately on my arrival in Middleton, I met the officers of the Authority, and convened a meeting of the Town Council, at which I advised as to the measures of precaution to be adopted. These were actively carried out. They included measures of cleansing and disinfection, the destruction of bedding and clothing, medical visitation of houses that had been affected and of neighbouring houses, as well as the addition of "diarrhœa" to the list of notifiable diseases.

No. 6.

Report upon a fatal Case of Cholera in Westminster; by Dr. R. Deane Sweeting.

In accordance with instructions I made inquiry into the circumstances attending the death of Martha B. (aged 50), living in Marsham Street, Westminster.

The case was notified on September 7th, 1893, after it had proved fatal, to the Medical Officer of Health to the Vestry of St. Margaret and St. John, Westminster, by Dr. H. Scott, of 27, St. Ermin's Mansions, as "choleraic diarrhœa: cholera." The Acting Medical Officer of Health, Dr. J. Norton, thereupon gave information to the Local Government Board.

I found that the deceased, a widow, living with two daughters (aged 15 and 13), in one room, in Marsham Street, was employed as a "cleaner of the members' private rooms," at the House of Commons. She went to work there as usual on the morning of Tuesday, September 5th, at about 8 a.m., but returned home about 11 a.m., complaining of "violent pains in the inside" and in her back, vomiting, and profuse diarrhœa. Dr. Scott was called in at about 6 p.m. His assistant, Dr. Collier, first saw the case, and shortly afterwards Dr. Scott himself. He continued in attendance during Wednesday, September 6th, and saw the woman for the last time at 10 p.m. on that day. She died at 1.30 a.m., September 7th.

Mrs. W., of Barton Street, Westminster, sister-in-law of the deceased, who nursed the deceased during the greater part of her short illness, stated that, besides the sickness and frequent watery stools, there were cramps, hot and cold flushes, blueness of the hands and feet, and, latterly, great prostration and collapse.

Dr. Scott and Dr. Collier, who attended the deceased, stated that the patient had copious frequent "rice-water" stools, much retching and vomiting, cramps in the arms, but more so in the legs, blueness of the hands and feet (but more of the former), sunken eyes, livid complexion. The temperature was subnormal (95·2° to 95·4°) throughout; the pulse was feeble, "thready," and quick. The patient was intensely restless, throwing her arms wildly about, and she suffered from intense thirst. Her urine was diminished in amount, if not suppressed.

In company with Dr. Norton, and the Sanitary Inspector, I made a personal examination of the body on September 7th. The belly was tumid, and there were evidences of early post-mortem discolouration.

The house in Marsham Street is a ten-roomed house; two of the rooms were at the date of inspection empty, and the rest occupied by seven families, including that of the deceased. I could learn of no diarrhœal illness amongst the other six families. The rooms were occupied by a poor class of people and were not overclean. That of the deceased on the second-floor, however, was rather above the average of the others. There was some accumulation of refuse in the small backyard at the time of my visit. But this would be a nuisance common to the whole of the tenements, six of which were not invaded by diarrhœal illness.

I inquired minutely as to the deceased's habits and doings. She was a quiet retiring woman who seldom went out or received any visitors. She had received none such for some time, and had not been out of doors the week previous to her attack except to her work, save on

Saturday afternoon and evening. On the Saturday afternoon, September 2nd, she went out for an hour to seek for a new room in Smith Square, Westminster.* And in the evening she went out to a pork butchers, in Tothill Street, where she purchased some pickled pork and a rabbit for her Sunday's dinner.

(The deceased was accustomed to do half a day's washing every three weeks at a house in Smith Square. She last did so on August 21st. I made inquiry, and found that no illness, of diarrhœal or other sort, had taken place at this house.)

I ascertained that the pickled pork and rabbit bought on Saturday (September 2nd), was partaken of hot on Sunday (September 3rd), at 1.45 p.m. by the deceased and her two daughters. Besides that, they had no other food on that day with the exception of tea and bread and butter. On Monday (September 4th) all three of them had the same dish cold. That day, at about 3 p.m., both the daughters were attacked with pain in the stomach and diarrhœa. The mother, too, had slight diarrhœa at the same time, which, however, got so much better by the evening that she partook of some of the cold rabbit that was left. The daughters continued to have diarrhœa all Tuesday, whilst the mother was violently seized at 11 a.m., as before related.

Some of the stools passed by the deceased on Tuesday night, collected by Mrs. Walsh for Dr. Scott, were handed over by me to Dr. Klein for examination. Dr. Collier and I performed a necropsy of the deceased, and 12 inches of the lower part of the small intestine were also forwarded to Dr. Klein for examination.

[Examination of this material is reported to have shown the rice-water like character of the stool and of the bowel contents, together with a congested state of the ileum. Both contained comma bacilli; and the ileum contained numerous epithelial flakes crowded with bacilli which morphologically and culturally were typical of Koch's comma bacilli. For details, see page 177.]

* Her daughter alleges that both she and her mother noticed a peculiar smell in this room. I visited it, but was unable to corroborate this statement. The room was apparently clean and in good condition.

No. 7.

Memorandum as to Advice given with regard to Disinfection of Certain Portions of the House of Commons, in consequence of a Death from Cholera in the person of one of the Women Cleaners employed there; by Dr. S. Monckton Copeman.

In accordance with instructions I went over to the House of Commons on September 7th, 1893, at 4.30 p.m., in order to inspect certain portions of the premises and to advise as to what methods of disinfection might be necessary. I remained there in consultation with various officials till 8 p.m.

I first saw the Chief Inspector of Police on duty in the House, who referred me to Colonel Legge, the Deputy Sergeant-at-Arms. Failing, at first, to find him, however, I asked for the chief official of the Clerk of the Works' Department.

From Mr. Prim, who was acting temporarily for the Clerk of the Works, and from his assistant, I learnt that the woman in question was Martha B., that she was 50 years old, and further that she was employed in the department of the Sergeant-at-Arms, in sweeping and cleaning certain rooms in one particular section of the House, which, as I afterwards learnt from Colonel Legge's books, included:—

The Members' Private Secretaries' Writing Room.
The Conference Rooms.
The Public Bill Office.
The Votes and Proceedings' Offices.

All these rooms, together with a small washing closet and a small store-room opening to Westminster Hall, are self-contained in one particular block.

In reply to questions as to the water-supply of the House, Mr. Prim informed me that the greater portion of the water was obtained from the Government Works at Orange Street, at the back of the National Gallery, being raised from the Thanet sand and chalk beneath the London clay. At the entrance to New Palace Yard, however, an admixture takes place with a certain proportion of water from the Chelsea Company's main. This mixture is supplied throughout the House. He thought it unlikely that any water would have been drunk by cleaners while on duty.

I next saw Colonel Legge, who told me that the duties of the cleaners extended from 8 a.m. to 12 noon, with slight variations. He also stated that Mrs. B. had had charge of the same set of rooms during the whole of the present session, and it was not likely that she had been into any others. The dust, tea leaves, &c. that would be collected, she would take down to a small yard off the Star Court, which is approached by a narrow stairway from the rooms she had to tend. In this yard the contents of dust-pans, &c. are placed in three iron pails which are emptied every day, and cleaned every other day by being scraped and washed. At the base of this stairway, adjoining the entrance to Westminster Hall, is a w.c., and next door a sink and urinal. She would, he added, have thrown any washing water down this sink.

At my request H. B., an office-keeper having charge of this portion of the building, was called in, and Mrs. H. and Mrs. G., two cleaners who had known Mrs. B. fairly intimately, were sent for.

H. B. said that he frequently came across Mrs. B., and that she had always appeared a delicate woman. He had heard that she had been more or less troubled with diarrhœa for several weeks past, although he was not aware that she had made any complaint on Monday last. He added that Mrs. B. had told him that she had frequently used a closet adjoining the Members' lavatory. She had mentioned this to him

App. A. No. 7.

On Disinfection of certain portions of the House of Commons after death of a female cleaner from cholera, by Dr. Copeman.

because a cloak-room assistant had "looked black" at her for using the closet.

Mrs. H. said that Mrs. B. had complained to her on Tuesday morning that a rabbit (Ostend) and pickled pork, which she had had for dinner on Sunday had disagreed with her, although at that time she looked quite well. Mrs. B. also told her that the drains had recently been up at her house, and that the filthy soil had been spread out in the yard. Mrs. B. had also mentioned that she had made use of the closet at the Members' entrance (at the bottom of the stairway already mentioned).

Mrs. G. said she did not work in the same rooms as Mrs. B., but she had walked home with her at noon on Tuesday, when Mrs. B. told her that she had been very ill, having suffered from severe diarrhœa all the morning. She had not seen her on the previous day.

On Tuesday evening Mrs. G. called to see her, when she found Mrs. B. in great pain, suffering from cramps and looking very ill. She had also been sick and exclaimed "its cholera, its cholera" Mrs. G. was so overcome that she left, and did not see Mrs. B. again alive. She could not say whether Mrs. B. had been sick in the House of Commons.

I then visited the rooms in which Mrs. B. had worked. They all communicate with one another on three sides of a court-yard. Just by Westminster Hall I found a small washing closet, from which the water had been cut off and which had been used by Mrs. B. for storage of pails and brooms. This place it seems possible she might have used in the event of being suddenly taken with sickness, especially as it is secluded.

On returning to Colonel Legge's room, I found there the Sergeant-at-Arms, and Colonel Carrington, while Sir Walter Foster came in shortly after.

I stated to them the results of the inspection that I had made, and what appeared to be desirable to be carried out in the way of disinfection.

My suggestions were as follows:—

1st. That all cleaners and other officers who might have come in contact with Mrs. B., either in the House, or at her own home, should be medically examined to ascertain whether they were suffering from diarrhœa.

2nd. That the closets adjoining the Members' lavatory and also the one by the Members' entrance, which all drain to one manhole in Star Court, and also the small washing closet adjoining Westminster Hall, should be thoroughly flushed out with a strong solution of perchloride of mercury.

3rd. That the carpets of the rooms in which Mrs. B. had worked should be taken up and disinfected by steam-heat, and that the floors should be scrubbed with a solution of perchloride of mercury.

I informed the First Commissioner of Works that the Sanitary Authority of the parish of St. Margaret and St. John, Westminster, would be willing to carry out the disinfection of the drains, but could not attend to the carpets, as they did not possess a steam disinfector.

To this course he agreed, and it was arranged that such disinfection should be carried out within a few hours. It was also arranged that the carpets should be taken up by workmen on the premises and sent to some firm undertaking the work of disinfection by steam-heat, and that the floors should be scrubbed, this to be done under the personal supervision of the acting Clerk of the Works.

The work was carried out in a satisfactory manner.

September 8th, 1893.

No. 8.

Report upon an Outbreak of Cholera in the Ashbourne Urban Sanitary District, Derbyshire; by Dr. R. Bruce Low.

This outbreak began on September 6th, 1893. During the seven days ending September 12th, 15 attacks of cholera occurred, all among persons residing in the yard behind the "Coach and Horses" public-house. Of the 15 cases, nine proved fatal. Three of the persons who had at the time of inspection already recovered had mild attacks. Of the three who were still under treatment, all of whom had severe attacks, two remained in a critical condition for some days, but ultimately recovered.

The first case was a delicate woman, the landlady of the "Coach and Horses" Inn. She had not recently been from home. She had slight diarrhœa on Monday and Tuesday, September 4th and 5th. She developed choleraic symptoms on Wednesday, September 6th, and died on the 7th. The course of the outbreak can be followed in the appended table:—

Wednesday, September 6th, one case which was fatal.
Thursday, September 7th, three cases, two of which were fatal.
Friday, September 8th, two cases, one of which was fatal.
Saturday, September 9th, five cases, three of which were fatal.
Sunday, September 10th, two cases, both of which were fatal.
Monday, September 11th, no cases.
Tuesday, September 12th, two cases, both recovered.

The symptoms in each case were similar, and Dr. Littleton, the medical officer of health, who had had some experience of cholera elsewhere, says he recognised the disease as identical with that which he had seen in 1866. The main characters were violent vomiting, profuse purging (the stools resembling rice-water), more or less suppression of urine, cramps, collapse, subnormal temperature, and in some fatal cases coma before death. A portion of the intestine from one of the fatal cases was sent by Dr. Littleton to Dr. Klein, who, after a bacteriological examination, pronounced the results as giving positive indications of Asiatic cholera.

Dr. Littleton from the first suspected that polluted water was the cause of the outbreak, and on Saturday night, September 9th, he gave instructions that the pump attached to the well in the "Coach and Horses" yard, should be put out of gear, so that water could not be got from it. To this precaution is probably due the cessation of the attacks, the last being on Tuesday the 12th. The Medical Officer of Health in consultation with Dr. Barwise, County Medical Officer of Health for Derbyshire, took further steps with a view to prevent extension of the disease. On Tuesday, September 12th, the well was emptied, and three hundredweight of quicklime was put into it. The yard drains were flushed with disinfectants; soiled linen was steeped in disinfecting solution; contaminated bedding was burnt, and other necessary precautions taken, apparently with good effect.

The public-house along with another dwelling forms the north-east end of the yard which has a row of six houses on the west side of it, the other side being occupied by a wooden shed. There are altogether eight houses in the yard, with a total population of 39 persons.

Cholera appeared in six of the eight houses. The people were, for the most part, uncleanly in their habits, and dirty in their persons; lice in the head, and fleas on the body, being in evidence at my visit; indeed, for many years the yard has had the reputation of being one of the dirtiest and most disreputable in Ashbourne.

App. A. No. 8. Dr. Cholera in Aylesbury in 1894. By Dr. Ransom Low.

The six houses on the west side of the yard have only two rooms apiece, one upstairs and one down; they have no doors or windows at the back, and therefore no through-ventilation. Some of these houses are in bad repair. There is a double water-closet at the south-west end of the yard facing and about 10 feet from the door of the last house, (*see* Plate II.). Both of the closets are flushed by hand and were found to be in a filthy state. One basin has been roughly constructed with bricks and the joints of these retained the excrement, giving rise to a grave nuisance, so much so that the people in the lower house had been obliged to keep their door shut all the summer to keep out the stench arising from the closet.

The "Coach and Horses" Inn, is practically an unregistered common lodging-house, accommodating 12 or more "travellers." These consist of low-class hawkers, Irish harvesters, and other nomadic folk, who come no one knows whence, and go no one knows whither. People living close by give a bad account of the habits of these "lodgers." The charge for the night's lodging is from 4*d*. to 6*d*. There is a water-closet, also hand-flushed, inside the public-house, placed against the outer wall just beside the pump (*see* Plate I.). Close by is an urinal which, is often, it is said, extemporised as a privy on Saturday nights. In the yard is a slop gulley close to the pump with an old metal trap, the surface of the ground round this gulley is in no way protected to prevent soakage. Down this gulley, or rather over it, an eye witness stated, he has seen pails of human excrement emptied. The evacuations are passed sometimes in the houses into a pail which is emptied upon this gulley. In the centre of these sources of pollution is situated the well, which is 14 feet in depth. Water stands usually about 7 feet in the well, the sides of which are only dry-steined. The subsoil is gravel and sand, and therefore very porous.

The relation of the above sources of filth pollution to the well are shown in Plate I. All the persons in the houses attacked during this cholera outbreak used the water from this well for domestic purposes. The inmates of two houses only where this water was in use escaped attack. There can be no question that the well had been fouled from one or all of the three following sources, viz. :—

(1.) The soakage of filth from a broken soil pipe leading from the water-closet, in the "Coach and Horses" Inn, underneath which closet at the time of the outbreak the subsoil parallel to the well was found saturated with excrement to a depth of 4 feet or more, *and only* 18 *inches from this well.*

(2.) The urinal (*see* Plate I.) which was situate only 3 *feet from the well.* This urinal is a wooden erection provided for the customers of the "Coach and Horses." The bottom of the urinal is bricked, but the wooden wall next the well is saturated with urine which escapes into the subsoil close to the well.

(3.) A yard gulley *situated only* 1 *foot from the well,* and on which slops and excrement are frequently poured by the people living in the yard.

The pump attached to the well is placed directly above it. The well is covered by a few boards and about 2½ feet of loose soil. The well is not protected from the return of water spilled at the pump in the process of filling water vessels.

Samples of this well water were submitted to Dr. Klein for bacteriological examination He found them to be teeming with true cholera bacilli.

It should be mentioned that occupiers of dwellings in the yard often receive for a single night or longer lodgers of the tramping class who are unable to be accommodated at the "Coach and Horses." This well must have received soakage through the closet of the bowel discharges of strangers, and in this way probably the specific poison of cholera was deposited in Ashbourne. Unfortunately all efforts to trace the individual or individuals who caused the mischief have failed.

The Ashbourne "wakes," the great holiday season for this locality, began on August 20th, and lasted to the 26th. At this time many strangers visit the town, and many visits at a distance are made by the inhabitants. Special trains took numbers of Ashbourne people to Blackpool, Liverpool, and Manchester. It is, however, more likely that the disease was brought by some ambulant case of the tramp class who may have come to the town during the wakes week; and who, while staying at the "Coach and Horses," specifically polluted the closet, and through it the well. As an instance of this in the case of another disease, I may mention that about a month before my visit a man was removed from the "Coach and Horses" to the workhouse suffering from a typical attack of enteric fever.

Every summer and autumn there is a recurrence of "summer diarrhœa" in Ashbourne. This year (1893) it was stated that the number of cases had been greater than usual. None of the cases, however, are said to have shown any of the virulent choleraic symptoms which characterised the outbreak in the "Coach and Horses" yard. Two of them occurred close by this yard; one case, a child, aged two years, was attacked on September 8th, but recovered after five days' illness. There was a possibility that this child had played in the "Coach and Horses" yard, and might have received specific infection there. The drinking water ordinarily used by this child was obtained from another well than that already described, and situate 25 yards from it. The other case, a woman aged 71, began on September 9th. She was a charwoman living in a yard adjoining the "Coach and Horses" yard. She had no vomiting or other symptoms beyond diarrhœa. She recovered in four days. Her drinking water was obtained from a well situate close to the house, the same as that from which the child referred to would usually get its supply.

The population of the Urban Sanitary District of Ashbourne was 3,810 at the last census. The water-supply is from wells, all more or less liable to pollution. A scheme for a new water-supply piped from a spring two miles from the town was adopted by the Urban Authority at a meeting held on September 15th, and a loan of 7,000*l.* is to be applied for at once to defray the cost.*

Considerable opposition has been offered by a section of the public in the town to the proposed new scheme which had at the date of my visit been before the Authority for some 12 months. When a poll of the ratepayers was taken it showed a majority of only 50 votes in favour of the new supply.

The condition of Ashbourne is such as to favour the spread of cholera or any other filth disease, and it is a matter of great urgency that a new public water-service should be completed with as little delay as possible. The Urban Sanitary Authority at the time of my visit seemed anxious to push on this greatly needed improvement, but they have in past years been altogether apathetic in respect of sanitary improvements in the town.

* This scheme fell through owing to legal difficulties.

DESCRIPTION OF PLATE A.

1. The well in the "Coach and Horses" yard (it had been uncovered at the time the photograph was taken).

2. The pump immediately over the well. (At the time the photograph was taken a temporary pipe had been attached to convey the water pumped from the well to the gulley in the process of emptying it.)

3. The gulley close to the well: down this excrement had been commonly emptied by the inhabitants of the yard.

4. Window of the "Coach and Horses" watercloset close to the well, alongside of which filth from the broken soil-pipe had been accumulating for some time.

5. The urinal used by the customers of the "Coach and Horses."

6. Back entrance to the "Coach and Horses."

PLATE A.

PLATE B

PLATE B.

1. The double water-closet at the end of the "Coach and Horses" yard, for use of the six houses, and situated 10 feet from the door of the last house, which door had to be kept shut all the summer owing to the foul smells emanating from the defective closet.

No. 9.

App. A. No. 9.

On Cholera Occurrences in Malton R.S.D. in 1893; by Dr. Copeman.

Report on the Circumstances attending the Occurrence of certain Cases of Cholera in the Appleton-le-Street Division of the Malton Rural Sanitary District; by Dr. S. Monckton Copeman.

In consequence of the receipt of a letter from Dr. Colby, the Medical Officer of Health for the Malton Rural Sanitary District, in which he stated that he had received two notifications of "Choleraic Diarrhœa? Cholera" from Appleton-le-Street, I received instructions to visit Malton, to investigate the circumstances of the cases, and to advise the officials of the Authority as might be necessary.

I arrived at Malton on the evening of September 21st, and was met by Dr. Colby, with whom I had made an appointment by telegram. He gave me a brief outline of the information which he had up to that time been able to gather, with reference to the cases which had been notified to him, and we arranged to visit Appleton on the following day; he also gave notice to the Inspector of Nuisances to meet us there.

Upon arrival at the village, I learnt that one house only had been invaded. This was a somewhat small, but fairly substantial, detached stone building, situate close to and on a level with the main road. Behind the house the ground slopes down from the road at a somewhat considerable incline, to pasture land which forms part of a small freehold farm property to which the house also belongs.

At the time of our visit, the only person in the house was an old woman, from whom, on account of her condition of chronic alcoholism, but little reliable information was to be extracted. While there, however, the medical attendant, Dr. Steer, and Alfred B. an intimate friend of the former occupier, joined us and mainly from them and from Dr. Colby, I gathered the following particulars as to the cases which had occurred. These I now set down in chronological order.

Case 1.—John E. (the owner of the small freehold above mentioned), aged 28, died on September 10th, 1893. For years he had been a free drinker and had suffered chronically from diarrhœa which was believed to be dependent on cirrhosis of the liver. He had been accustomed every now and again to leave home on a drinking bout; and with this object he went to Scarborough on August 31st and stayed at Hampton Road at the house of Mrs. W., half sister of his wife. Here he was joined on September 5th by his friend B., who remained, however, for one night only. B. stated that at this time John E. was obviously the worse for drink, but otherwise appeared to be in his usual health. He further stated that John E. had spent most of his time either at the cricket-field (it was the Scarborough cricket week) or inboating on the sea. He had apparently eaten little, but had been drinking heavily. As far as was known he had no fish or indeed any food, beyond the little he took at the house where he was staying, with the exception of some oysters, of which on at least one occasion he had partaken copiously at a stall on the sands. He left Scarborough late at night on Wednesday, September 6th, and complained of feeling ill before his arrival at Appleton. Next day, after arrival at Appleton, he suffered from severe diarrhœa, and he is believed to have paid several visits to a privy which is built against the side of his house at Appleton. On Friday, September 8th, he was so ill that his friends sent for Dr. Steer, who on his arrival found John E. conscious indeed, but collapsed and pulseless, with sunken eyes and blue lips, his limbs "icy cold" to the touch, and complaining of severe cramps. He had apparently no control over the bowels, and was passing more or less continuously watery stools of a milky appearance and bad smell. He died in the early hours of Sunday, September 10th.

This case was not specially reported at the time, as his symptoms were looked upon merely as an exaggeration of his normal condition, and it was only on the subsequent occurrence of other cases in the same house that the probability of the disease in John E.'s case having been true cholera suggested itself.

Case 2.—Mrs. R., a sister of Mrs. E. (wife of John E.), came from Terrington to Appleton on September 10th, on learning of the death of her brother-in-law. She remained apparently in perfect health until the morning of the day on which the funeral of John E. took place (September 12th), when she was attacked with diarrhœa, but having no sickness and but little pain, she did not at once take to her bed. Her symptoms appeared, for a time, to be ameliorated by a pill of lead and opium, together with some chalk mixture. She was naturally rendered somewhat prostrate by grief, and cramps in the limbs coming on she went to bed, almost immediately after the funeral. At the time of my visit (on September 22nd) her motions were loose, but appeared fairly normal. Though she then seemed to be still in a somewhat critical condition, she ultimately recovered.

Case 3.—This was the case of George B., aged 70, father to Mrs. E., He lived at Terrington, a village about five miles distant from Appleton, but went on September 12th to John E.'s funeral, after which he returned to his own house. At this time he was in good health. On Monday, September 18th, he went to Appleton again to stay with his daughter for a few days. On the following day he walked to Malton to attend the market, leaving Appleton about 9 a.m. He did not have any dinner at Malton, but was heard to ask in a public-house for three pennyworth of gin; a most unusual circumstance, as he was practically a teetotaller. Whether or not he felt ill at this time is not known, but on the way back to Appleton he was attacked with abdominal pain, cramps and severe diarrhœa, so that from Swinton, a place less than two miles distant from Appleton, it took him an hour and a half to reach home. No sooner had he arrived there than he was seized with an attack of vomiting. At 5.30. p.m. (September 19th) he was seen by Dr. Steer. At that time he was collapsed and pulseless; the skin cold and the toes bent up by cramp. A thin watery fluid containing whitish flocculi was running, almost continuously, from the bowels. On trying to rise in bed, because of an attack of vomiting, he fainted. Hot water bottles were placed in the bed and friction applied to the limbs; the latter treatment appearing to relieve the cramps somewhat. Dr. Steer paid another visit at 1.15. a.m., on Wednesday morning (September 20th), when he gave a hypodermic injection of ether. George B. died, however, about an hour later. It was noticed after death that the skin, particularly of the limbs, was much puckered and wrinkled.

Case 4.—Blanche E. aged 27, the wife of the first patient, and daughter of the third, died on September 20th, about 12 hours after her father. She appeared to be quite well when Dr. Steer visited George B. on the previous day, but, about half an hour after he had left, she was attacked with diarrhœa, vomiting, and cramp. She took a dose of chalk mixture and a neighbour applied friction to the legs. At 1.15. a.m. (September 20th) Dr. Steer saw her, when he considered that though she had an anxious look and was suffering from cramp in the limbs, she was by no means *in extremis*. An hour later, however, she became much worse, and she passed typical "rice-water" stools almost incessantly. She retained consciousness throughout and Dr. Steer, who remained with her to the end, told me that he thought that some slight improvement had set in, when she died somewhat suddenly. A portion of the ileum from this case was sent to Dr. Klein, who stated that the results obtained, microscopically and bacteriologically were typical of cholera.

Mrs. E. had, I found, slept on Monday night (September 18th) in the same bed in which her husband died; in order to give up her own bed to her father. The bed-clothes in which she slept had been saturated with the discharges of the first patient, and although they had been hung up to dry in the open air, they had never been washed or disinfected in any way. A girl, of whom further mention will be made later on, also slept with her. Mrs. E. had attended her husband during his illness.

I made careful inquiries as to the food and drink which had been partaken of by the last three cases, but could discover no circumstance of a suspicious nature in this direction, as it appeared that no one of them had had anything which had not been also, in part, consumed with impunity by other persons. Some complaint was made, locally, as to the water supply, which was obtained from a surface well situate at the bottom of the hill, behind the house, and which was very imperfectly protected from surface pollutions. Accordingly, at my request, samples were taken, one of which was analysed chemically, while the other was sent to Dr. Klein for bacteriological examination. The water proved to be of bad quality, owing to organic impurity, but no proof could be obtained that it had become specifically infected with the cholera organism.

Case 5. A child aged 16, a daughter of Mrs. W. of Scarborough, and niece of Mrs. E. This child, who had slept in the same bed with her aunt on September 18th, had been staying at Appleton, but was taken back to Scarborough (where I saw her) by her father on September 21st, the day following that on which George B. and Mrs. E. had died. Unfortunately, the child is deaf and dumb, so that it was impossible to extract much information from her, but through her mother, I learnt that she had, as might have been expected, used the same privy as the other persons at the Appleton house. At the date of my visit to Scarborough I found the child was suffering from a fairly sharp attack of diarrhœa and had complained of some pains in the body. The Medical Officer of Health (Dr. Monk) promised to visit the patient every day, and if it should appear desirable, to send some of the stools to Dr. Klein for examination. I have since heard from him that the child has recovered entirely, and no similar symptoms have appeared in any other of the inmates of the house.

On inquiry of Mrs. W., at Scarborough, I learnt that six persons had been staying in the house at the time of John E.'s visit. None of these persons, except John E. himself, had partaken of any oysters. All other articles of food they had had in common. With the solitary exception of the child above mentioned, not one of these persons had any diarrhœal symptoms.

I also took the opportunity, while at Appleton, of going to Terrington, the village in which George B. had lived. At his house, which was of a somewhat superior type, I found his widow, an old woman 70 years of age, and also a girl of about 16 years old named K., who had, she said, stayed at Scarborough during the time that John E. had been there. These two persons appeared to be in perfect health, and I learnt that George B. had not suffered from any illness for some considerable period, prior to his visit to Appleton. I also saw the local medical practitioner, who stated that the district had been singularly free from diarrhœa of late.

The cases of cholera and choleraic diarrhœa were therefore entirely confined to those who had been inmates of John E.'s house at Appleton; all the inmates, whether permanent or temporary, being affected to a greater or less degree. And there are grounds for believing that the later cases owed their infection, either directly or indirectly, to John E., who in all probability, himself contracted cholera while at Scarborough

Owing to the fact that, by a process of exclusion, it appeared possible that John E. had contracted the disease as the result of eating a quantity of oysters, while in a broken-down state of health, I made some inquiry at Scarborough, with the assistance of Dr. Monk, the Medical Officer of Health, as to the source of the oysters and other shell-fish that were sold in the town.

For this purpose, we first visited the stalls on the beach where John E. had obtained the oysters he had eaten. Here we found that no shell-fish, other than oysters, were sold, and these, we were informed by the stall-holders, came almost entirely from two wholesale dealers at Cleethorpes. In addition, we visited all the shell-fish shops in the town, but, at several of these, we were unable to obtain any reliable information, as a rumour had apparently got abroad as to the object of our visit. In two instances, however, we found that both oysters and cockles were obtained from Cleethorpes.

At the time of my visit to Appleton, I ascertained that, by direction of the Medical Officer of Health, all suspected bedding, including sheets, mattresses, feather-beds, and rugs had already been burnt, as had also the carpets and curtains of the bed-rooms. In these rooms also the paper had been stripped from the walls, and the floors had been scrubbed.

I found, however, that an outside box-privy which had been built against the house at a point adjacent to the larder, and which had apparently been used by all the inmates of the house in the earlier periods of their illness, had not been cleansed or disinfected. The box was almost full of semifluid material, which exhaled an extremely unpleasant odour. I suggested, therefore, that the box should immediately be filled up with carbolised sawdust, to prevent any fear of the contents being spilt, that it should then be removed to a distance, be saturated with paraffin oil and burnt. I have since learnt that this procedure was carried out by the Medical Officer of Health himself, the Inspector of Nuisances having refused to undertake the work. I also strongly advised that the privy should be removed altogether, and rebuilt a short distance from the house, and I have reason to believe that this will be done.

I append an extract from the death returns, obtained from the local Registrars of the Malton Rural Sanitary District, showing the number of deaths from diarrhœa which had occurred in the district between August 1st and September 23rd, 1893.

Malton Rural Sanitary District.
Registration of Deaths from Diarrhœa.
August 1st to September 23rd, 1893

Sex.	Age.	Cause of Death.
F.	73 years	Diarrhœa. 8 days.
F.	6 months	,, 3 days.
M.	2 months	,,
M. (John E.)	28 years	Chronic Alcoholism. *
F.	12 weeks	Diarrhœa.
F.	4 months	,, and Bronchitis.
F.	4 months	Acute Diarrhœa.

* Diarrhœa not mentioned in Death Certificate.

None of these cases, with the exception of John E.'s, occurred at Appleton.

App. A. No. 10.

On Cholera and Choleraic Diarrhœa in Gainsborough R.S.D.; by Dr. Bruce Low.

No. 10.

REPORT on a CASE of CHOLERA at MORTON and on CASES of CHOLERAIC DIARRHŒA at OWSTON FERRY, in the GAINSBOROUGH RURAL DISTRICT; by Dr. R. BRUCE LOW.

ON September 7th, about 3 o'clock in the afternoon, J. R., aged 56, and residing at Morton, was taken ill with diarrhœa while at work in the fields. The parish of Morton had in 1891 a population of 1,137. He was brought home in a cart, and rapidly developed symptoms identical with those of cholera, from which he died about 10 o'clock the following morning, September 8th, his illness having lasted only about 19 hours. Bacteriological examination of a portion of the bowel resulted in Dr. Klein declaring that the "cultivation "experiments showed the case to have been decidedly Asiatic cholera." The case at the beginning was seen first by Dr. Passmore of Gainsborough, and later on by Dr. Wright, the Medical Officer of Health. Both of these gentlemen regarded the case from the first as one of true cholera.

The household comprised, in addition to J. R., his wife and three grown-up sons. One of the sons paid a visit to Hull to some relatives, on Monday, August 28th, and returned to Morton on August 31st. This young man states positively that neither during his stay at Hull, nor afterwards had he noticed any relaxation of his bowels. He further stated that he had brought home with him on August 31st a halibut, which he had bought, at the dockside in Hull, the same morning. It was in a perfectly fresh state, and part of it was cooked and eaten by the family the same evening. The next morning, Mrs. R., aged 50, wife of J. R., was attacked with diarrhœa which lasted till September 5th. While at the worst she had, according to her statement, about 10 motions a day. She had no vomiting, but there was some "twitching" or griping in the body. She was at the time of her attack in delicate health, having just recovered from influenza. No other case of diarrhœa followed in this house till the fatal attack of J. R., on the 7th September; but on Saturday, the 10th September, one of the other sons suffered from looseness of the bowels; this lasted only about 24 hours. He had no vomiting or cramps, and could take his food as usual. There was, he states, "a dull pain in his body," and he "felt rather faint at times."

J. R., who died, had been previously a healthy man. He, at long intervals, occasionally took too much beer. He had not been recently from home, with the exception that on Monday, September 4th, he was at West Stockwith Fair (about 3 miles distant). He had nothing at Stockwith except some bottled beer. Two of his sons went to Doncaster (St. Leger) Races, on Wednesday, September 6th.

J. R., along with his three sons, farmed some 20 acres of land near Morton. This land was manured with stable litter and contents of privy middens got in Morton, and led in their own cart to the fields. One day during the same week that J. R. was attacked (the precise day could not be stated) he and his sons had emptied several midden privies, and taken the contents to their land. On the morning of September 7th, the day of his illness, the privy midden in his own yard was emptied by two of the sons, the father assisting. He "cleaned up" the yard after the emptying was completed. About two cart loads of excrement and ashes were taken out of this privy midden, and among this would be the diarrhœal dejections of Mrs. R. (who suffered from September 1st to 5th) and the bowel discharges of the son since his return from

Hull. The son who was seized with diarrhœa on September 10th was one of those who took part in this work.

These people were of cleanly habits, and their house, I am informed, was well-cared for. They suffered in no way from privation. The house is a double cottage, the other half being occupied by a family of eight persons, none of whom have suffered in any way recently from diarrhœa or similar illness. A narrow yard is behind the houses, common to both. This yard is of varying width, part of it being 12 feet, and part of it only 6 feet wide. Midway between the houses and close to the walls stands a pump well, said to be 20 feet deep, and used up to the death of J. R. by both families. The yard is paved in part with rough cobbles which permit water to stand on the surface. Through the yard runs a channel for slops, but this is unevenly laid, and permits pools to form.

The privy, which is connected with a deep but covered ashpit, is situate at one end of the yard. The privy door is 6 feet from, and almost facing, the back door of J. R.'s house. The privy discharges into a covered midden pit which is about 5 feet by 4 feet, and excavated 3 feet below the level of the ground.

* * *

While making inquiry at Morton into the circumstances attending the death from cholera there, I extended my inquiry to Owston Ferry, where, prior to my visit, Dr. Steen, the resident practitioner, had informed the Medical Officer of Health, Dr. Wright, that six fatal cases of choleraic diarrhœa had occurred in that village between July 31st and September 14th, 1893. I learned that, during the same period, a number of cases of diarrhœa, estimated at "50 or more," had occurred, and that the symptoms differed in severity in different cases. It appears that "summer diarrhœa" is comparatively rare in Owston. Dr. Steen stated that during the four or five years he had practised in the locality he has seen very little, if any, of it. There were no deaths from "infantile diarrhœa" during 1892 and 1893. The parish of Owston Ferry had in 1891 a population of 1,276. There have, however, been at least three cases of choleraic diarrhœa at Susworth (population, 150), on the opposite side of the Trent, three miles lower down the river, during the last few weeks. Dr. Steen saw one case there, and Dr. T. B. F. Eminson saw the other two. One of the latter cases was taken ill suddenly in the fields, and was brought home in a cart in a cold and collapsed condition; he recovered. A child of this patient died at Susworth early in the present year from acute gastric catarrh, having been seen only once, and then in a moribund state, by Dr. Eminson. The child's illness was mainly, at first, vomiting and purging. He died unconscious.

The dates of the fatal attacks at Owston and other particulars are given in the subjoined table:—

No.	Date of Death.	Initials of Case.	Age	Residence.	Duration of Illness.	Water Supply.	Excrement Disposal.	Symptoms.
1	July 31 -	Mr. J. D. -	49	Main St., Owston.	2 days -	Rain water and well water boiled.	Vault privy	Vomiting, purging, stools in no way resembling rice-water; thirst, cramps in feet. Died in a state of collapse.
2	Aug. 4 -	Mrs. E. W. -	80	„	10 „ -	Rain water boiled.	„	Vomiting, purging, pain in body; chills.

No.	Date of Death	Particulars of Case.	Age	Residence	Duration of Illness	Water Supply.	Excreta Disposal.	Symptoms.
3	Aug. 14	Mr. J. B.	82	Main St., Owston.	5 days	Treat water filtered.	Midden privy.	Vomiting, purging, [illegible]. Had [illegible] and considered [illegible] and [illegible] and [illegible] at the same time, he was the first [illegible] neighbour.
4	„ 21	Mrs. A. W.	85	„	10 „	Rain water tanked.	Vault privy.	Vomiting and [illegible] Had [illegible].
5	Sept. 11	R. C. (boy)	7	„	5 „	Treat water tanked.	„	Vomiting, purging. No [illegible]. Had [illegible].
6	„ 14	Mrs. J. T.	58	„	30 hours*	Rain water tanked.	„	Vomiting, purging, [illegible] to bed, and [illegible] Tenesmus [illegible] [illegible] symptoms of [illegible]. Vomiting. Collapse.

* This patient had been suffering from diarrhœa for some days before, but the symptoms existed for about 24 hours before the acute illness appeared, which lasted only about 30 hours.

The fatal cases were scattered along both sides of a long main street a quarter of a mile or more in length. There appeared to be no circumstances common to any group of them. The Medical Officer of Health was of opinion that the emanations from the sewer, which runs along this main street, were the cause of the illness. The sewer is of antiquated construction, square in shape, constructed of brick on three sides, the top being composed of flagging. There is no ventilation provided, and the gradient is almost nil. Its outfall is into a ditch which ultimately reaches the river. Although there is an arrangement by which at high tides a sluice can be opened and river water admitted to flush the sewer, yet there are, I am told, objections to this, arising from the fact that the muddy water silts up the flat bottom of the sewer and gives rise to obstruction by accumulations of solid matters along with the silt. There are some openings admitting surface-water from the gutters to the sewer, but during the recent hot weather, these openings were either untrapped or imperfectly so, and bad smells from them have been common. There is need of a new sewerage scheme for this large village.

Upon inquiry, I found that there were frequent and intimate intercommunications between Owston and the town of Hull by persons going regularly with produce to Hull market, and by persons going to reside with friends at that town, or Hull people coming on visits to relatives in Owston. As illustrating how easily choleraic disease may be brought, I may mention an instance where in a house at Owston there had been staying a visitor from Hull who came to the village suffering from diarrhœa, which lasted for some days during her visit. This visitor did not arrive in Owston, however, till August 17th, previous to which date three of the deaths from choleraic diarrhœa had already taken place. From the condition of the drainage of Owston, its water

supplies, and its methods of excrement and refuse disposal, it is evident that choleraic disease had facilities for spreading in the village; and that there existed ample opportunities for the importation of the disease from already infected localities such as Hull.

September 28, 1893.

No. 11.

Report on the Circumstances attending the Occurrence of Cases of Cholera and Suspected Cholera at Great Yarmouth; by Dr. S. Monckton Copeman.

In accordance with instructions I paid a visit to Yarmouth (population 49,334 in 1891) on September 28th, 1893.

On my arrival I attended a meeting of the Sanitary Committee of the Town Council, which I had previously summoned by telegram. Before the meeting, however, I was able to obtain certain important details, as to the existing state of affairs, from the Medical Officer of Health, who met me at the railway station.

At the meeting I called attention to the fact that, in addition to two or three highly suspicious cases, one of undoubted Asiatic cholera had occurred in the borough, and that it therefore was the duty of the authority at once to take all possible precautions for preventing, if possible, further spread of the disease.

In reply to questions I elicited the following statement as to what had already been done:—

1. A printed notice had been distributed to wherrymen which gives information as to where they can obtain fresh water for drinking and cooking purposes, free of charge. All wherries arriving at Yarmouth, of late, have been inspected, as to the presence of nuisances or of possible cases of infectious disease.
2. A printed notice had also been issued to mussel-dredgers warning them not to use river-water for cleaning shell fish.
3. A sub-committee of the Sanitary Authority, termed the Health Committee, was formed on September 8th, 1893, "with power to "carry out any measures that might be necessary to prevent the "importation into or the spread of cholera in the town." This sub-committee had had several meetings since that date.

After promising to meet the Health sub-committee on the following day, I went, in company with the Medical Officer of Health, the Inspector of Nuisances, and Dr. Ryley, the medical attendant, to see a child who had been taken ill with symptoms indicative of cholera an hour or two previous to my arrival in the town.

The child's parents live at No. 31, in "Row" 34, but the father is at present absent at sea. Four children live at home, their ages ranging from 16 months to 9 years, the eldest being the girl, Sarah Ann P., who had been taken ill. The house consists of three small rooms, one above another, each of which has a single window opening towards the Row; no means of through ventilation therefore being afforded. Arrived here, we found the patient lying in a state of collapse, on a sofa in the lowermost room, in which the mother and three other children were having tea.

With regard to the child's illness, I obtained the following particulars: She had been, to all appearance, in perfect health on going to bed the previous night (September 27th), but at 3 a.m., on the morning of September 28th, she woke her mother, with whom she was sleeping, stating that she had severe stomach-ache. Immediately after, the bowels were moved, the motion, according to the mother's account, being like water, and having very little colour. At 7.30 a.m. the child got up, but took no breakfast except a little tea, which she immediately vomited up. While in bed she had also made complaint of pains in the legs, and this symptom reappeared in the afternoon. About noon she

again vomited, the vomit being "like water," and at 1 p.m. she was seen by a medical man who gave some castor oil, which was speedily ejected by the stomach. The child at this time was very cold, and when the temperature was first taken at 4 p.m. it was found to be 95·2° F. A small quantity of bismuth and ammonia mixture had been given and retained.

At the time of my visit, the child was conscious, but apparently sleepy, not complaining of pain, but with beads of perspiration on the forehead. The skin was cold, the thermometer indeed refusing to register the temperature, which was necessarily therefore below 95°F. The eyes were sunken and the lips and hands were blue. The heart was beating at 134 per minute, but no pulsation was perceptible at the wrist.

The Medical Officer of Health told the mother that the child ought to be removed to the hospital, but this she refused to allow, being supported strongly in her opposition by several friends who had come in while we were there. Persuasion proving of no avail, a magistrate's order was after some delay obtained, and eventually, about midnight, the child was removed to the Isolation Hospital at Gorleston. On seeing the place, some relatives who had accompanied the child, stated that they had changed their opinions, and were quite content to leave her there.

Putting together briefly certain items of information that I collected at various places, I learnt that the girl, Sarah Ann P., went to school at the British School in the Market Place. She was said to be a quiet shy girl, who appeared to make no friends, as she always came to school and left it alone. One of the mistresses told me that the child had always seemed weakly, but had not appeared to be worse of late. She was always regular and punctual in her attendance, and had not been absent from school for a single day since the summer holidays until she was taken ill.

I further learnt that the child had, on the days previous to her illness, partaken of precisely similar food to the rest of the family, and with the exception of a little mackerel three days before, and an apple or two a week previously, had not had, as far as the mother was aware, anything in the nature of fish, shell-fish, uncooked fruit, or vegetables. Also, she had apparently remained in the house except when at school, it not being her habit like that of many of the children in the neighbourhood to play about in the "Rows."

Within a few doors of the house, but in the main road, is a shell-fish shop. The woman who keeps it informed me that she had supplied children living in the adjoining Row, from time to time, but she did not know their names. Her cockles are obtained from King's Lynn,* and the mussels locally. I was unable to obtain any evidence that the child, Sarah Ann P., had partaken of any shell fish lately.

The child still remained at hospital, and when I last saw her, there appeared to be considerable improvement in her condition, notwithstanding the fact that Dr. Klein certified that a specimen of rice-water stool passed on the first day of her illness, and which I had sent to him for bacteriological examination, was practically a pure culture of the true cholera bacillus. Dr. Klein's report on this case will be found in Appendix B., page 183. [I afterwards learnt that the child died, after a stay of about a week in hospital.]

On my first visit to the house, I found that a quantity of the watery bowel discharges had been thrown by the mother into an open channel,

* As to the origin of King's Lynn cockles, *see* Case III., page 143.

which runs the whole length of the "Row." This fact, having also come to the knowledge of the Medical Officer of Health, he had already had the channel copiously flushed with a strong solution of carbolic acid.

The following day (Friday), the whole house was fumigated with sulphur, and all hangings, &c., disinfected by high pressure steam; the linen actually used by the patient being burnt.

After making a round of visits in company with the Medical Officer of Health, in reference to other of the cases which had occurred in the town, I attended a meeting of the health sub-committee, to whom I gave some account of what I had done since my arrival in the town, and with whom I left a paper of recommendations as to precautionary measures, which I advised should at once be put in force in the district.

As the result of my inquiries, I had found that three other suspicious cases, of which two had terminated fatally, had previously occurred in the district.

Case I. An itinerant water-cress seller of age unknown (said to be about 56) an inmate of a common lodging-house, was reported to the Medical Officer of Health on September 8th as suffering from an attack of English cholera. It appears that he made his supper, on the previous evening, of some stale fish, which when fried gave out so unsavoury a smell that the keeper of the lodging-house advised him to throw it away. He was removed to hospital where he speedily recovered. The house was disinfected and the patient's clothes burnt. The symptoms, as related to me, did not appear to afford evidence that the case was one of true cholera, although he suffered from diarrhœa and cramps. He had left the town prior to my visit, and I could learn nothing as to his movements before or after his illness.

Case II. Mary Ann H., aged 53, a widow, living at No. 17 in "Row" 101. She had, I was informed, suffered at intervals for some years past with "spasms of the stomach" which were usually accompanied by some diarrhœa and sickness and occasionally by cramps. She had, however, been free from attacks since Christmas, when she was attended by Dr. Ryley. She had formerly also attended at the Yarmouth Hospital. On Monday, September 18th, Dr. Ryley was called to see her, she having been attacked with diarrhœa in the morning. Later in the day she vomited, and this occurred again in the night, when she also complained of cramp, especially in the legs. From 9 p.m. on Tuesday to 4 a.m. on Wednesday the 20th, she is stated to have slept peacefully. She then awoke her daughter, who slept with her, and before medical aid could again be obtained she expired. The motions are stated to have been very watery, but of a fairly deep yellow colour. Further I learnt that the eyes were not sunken, that there had been no blueness of hands or lips, and that the patient had made no complaint of being cold. For some days prior to her death she had taken but little food, but that little had been identical in quality with what was eaten by the rest of the family, who, to the number of four (3 sons and 1 daughter) had not suffered from any similar attack.

The patient was buried on Friday, September 22nd, and precautions taken with regard to disinfection as if the case had been one of true cholera. Whether in fact it was a case of this disease or not there is little positive evidence to show.

Case III. Alfred John M., aged 13 years, had been living with his parents at 26, St. Peter's Road, a part of the town remote from the "Row" District, and attended St. James' School.

This boy is stated to have suffered for a year or more from pleurodynia, which, according to his account, was always relieved by bathing. Whether for this reason or not, he is stated to have been in the habit of bathing

either in sea or river pretty nearly every day, and often more than once in the same day. He had last done so on September 16th, from which day onwards he is said to have suffered from slight diarrhœa.

With the exception of this looseness of the bowels and pain in the side, he had been quite well up to Wednesday, September 20th, when he complained of slight stomach-ache. This, however, had disappeared in the evening. He acted as errand boy to a Miss B., to whom he went before and after morning school, and on leaving home for her house on Thursday morning the 21st, he made no complaint of feeling ill, although he ate no breakfast, and afterwards refused to go to school. This latter fact, however, loses its apparent importance, as I found on reference to the school books that he had played truant on many occasions of late.

Later in the day he was seized with sickness, purging and abdominal pains. At 6.45 p.m. he was seen by Dr. Wrigley, who found him in a state of collapse, with sunken features, face and extremities cold, and of dusky hue, feeble pulse, and temperature of 95·2° F. Urgent vomiting and diarrhœa had set in, and a chamber utensil was found half full of a colourless watery fluid containing a whitish flocculent deposit. There was complete suppression of urine. The lad lay in an apathetic condition, but was conscious and answered questions. Dr. Wrigley ordered brandy at frequent intervals, with ice to suck. He was wrapped in blankets, and hot water bottles were placed in the bed. There was no complaint of cramp.

The case was seen by the Medical Officer of Health in company with Dr. Wrigley on the morning of Friday, September 22nd. There was now more profound collapse. Vomiting has occurred ten times in the night, but diarrhœa had ceased since the previous evening. The lad died about 2.30 p.m. on September 22nd. A portion of the ileum was subsequently sent to Dr. Klein for bacteriological examination, and he reported having obtained results typical of cholera. See Appendix B., page 182.

This boy's parents let out their rooms to lodgers in the summer months, and two had left on the morning on which the boy was taken ill. As far as is known these people had not suffered in any similar way. The sanitary condition of the house is good, and the water is supplied from the Company's mains. The boy had the same food as his parents and three other children, all of whom remained quite well. He is said to have been seen to pick up and eat a raw mussel from a stall, and it should be stated that almost next door to his home is a shell-fish shop, where fried fish and potatoes are also sold. As the boy's father is a fish-seller it is hardly likely that the boy would have gone out to obtain fish, but the owner of the fish shop in question admits that this boy had been in on several occasions for "chip" potatoes, but he did not know, he said, whether the boy had ever had any shell fish there. The stock of cockles is said by the owner to be obtained from Lynn, but I have received information that Cleethorpes cockles are now sold through Lynn, so as to hide the fact of their origin. The mussels, the shopman stated, were obtained locally.

As will be seen by the appended maps* of Yarmouth, a sewer draining the Royal Naval Hospital and some rows of houses between the Hospital and the river, opens just above the shelving beach of Beeching's yard, where A. J. M. was accustomed to bathe when taking a dip in the river. This sewer is very foul, and great complaints are made locally as to the stench from it. To prevent the nuisance in part, the end of the sewer

* Not reproduced.

has been taken beneath low-water mark. When I visited the spot I found a large box of eels, suspended in the water just over the sewer mouth, for fattening purposes. A. J. M. had said that he had frequently swallowed some of the water he was bathing in, and if this was the case, it would appear that he might possibly have received infection in this manner, supposing that the discharges of previous cases of the disease had been emptied into the sewer. Of this, however, although I made diligent inquiry at the Naval Hospital and elsewhere, I could obtain no evidence.

In accordance with my suggestions, the chief constable was directed to prevent bathing in the river below the bridge, and the Medical Officer of Health was directed to take steps to prevent the storage of eels in the same part of the river.

I have only to add that the whole house in St. Peter's Road was carefully disinfected under the superintendence of the Medical Officer of Health, and all soiled linen destroyed.

No. 12.

Report upon an Outbreak of Cholera in the Ilkeston Urban Sanitary District; by Dr. S. W. Wheaton.

In accordance with instructions I visited the town of Ilkeston in Derbyshire (population, 19,744 in 1891) on September 22nd, 1893. I then ascertained that since September 9th four cases of acute diarrhœal illness were known to have occurred in the town, of which three had ended fatally.

The particulars of these cases are as follows:—

Case I.—L., male, æt. 56, was engaged in collecting nightsoil from privies in the centre of the town early in the morning of September 14th. While at work he was seized with diarrhœa, and returned from work to his employer's house in the town. At 9 a.m. he started to walk to his home, about three-quarters of a mile away, but fell down in the street, and was taken home in a cart. He arrived home about 11 a.m. Whilst in the town he called at one or more houses, and is thought to have used the privies at several houses. On reaching home he vomited repeatedly, and his bowels acted very frequently; the stools were at first of a light yellow colour, but soon became "like water." The last three stools that were passed, shortly before death took place, were slightly brownish in colour. He suffered from severe cramps in the abdomen, arms, and legs, his features became shrunken, the eyes sunken, and his face and hands blue and shrivelled; he died on the afternoon of the 15th. No post-mortem examination was made.

Case II.—A., a female, æt. 20 years, had been going every day to see her brother, Case No. IV., who had been ill for some time. On the evening of September 18th, while at her brother's home, she was seized with vomiting and purging, together with cramps in the legs and stomach, and at once started to walk home to her house, which was half a mile away, in the centre of the town. She arrived home about 11 p.m., and called at one house on her way, where she is believed to have gone to the privy. After arriving home the vomiting and purging continued; the stools, which at first were light yellow in colour, soon became "like "water with little shreds floating in it." The patient subsequently became cold and collapsed, the face and hands blue, the voice faint; and she died at 7 p.m. on the evening of September 19th. A post-mortem examination was made by Drs. Barwise, Carroll, and Badcock; and a portion of the ileum was removed and forwarded to Dr. Klein, who subsequently reported that as the result of microscopic and cultivation experiments, the evidence as to cholera was positive.

Case III.—F. (1), female, æt. 17 years, who was living in the same house as her brother, Case IV., and who was sister of Case II. This patient, on September 15th, had a slight attack of diarrhœa, which, on September 19th, became very severe, the bowels acting quite 12 times a day, and was accompanied by cramps in the abdomen and legs. On the 20th the patient was much improved, after taking medicine; and on the morning of my visit (September 22nd) had gone to work at a needle factory, although very weak and ill, and still suffering from looseness of the bowels. The stools throughout the illness had been passed into the privy, and their character not noticed, except that they were very offensive. I saw this patient, and found her still very weak and ill, with shrivelled hands, and general pinched and pallid appearance The pulse was 60, and very weak.

Case IV.—F. (2), male, æt. 20. This patient had been ill for seven weeks before September 9th, on which date, after being considered convalescent for one week, he was taken suddenly with vomiting and diarrhœa; the bowels were opened from six to seven times a day, the stools were watery and light yellow in colour; he continued to suffer from diarrhœa and vomiting until the evening of September 17th, when he died. The original illness was regarded by Dr. Badcock as enteric fever, but as to the nature of the illness which ensued after the period of convalescence he cannot express an opinion.

The symptoms and course of the illness of Cases I. and II. appear to have been indentical with those of Asiatic Cholera; with regard to Case III., there appears to have been nothing typical. With regard to Case IV., it certainly seems that the patient did not die from a relapse occurring during enteric fever; since the presence of repeated vomiting during the relapse of enteric fever is an extremely uncommon symptom, and there was no abdominal distension, nor return of fever. The Notification of Infectious Diseases Act is in force in the district of the Ilkeston Urban Sanitary Authority, but diarrhœa is not included among the diseases to be notified.

During August of the present year there has been only one death from diarrhœa, and four deaths from gastro-enteric catarrh; all the deaths have occurred in persons under the age of 12 months. In September, up to September 15th, there have been three deaths from diarrhœa, two deaths from gastro-enteric catarrh, all in persons below the age of 20 months; and one death (Case No. I.) from cholera "Anglica."

I visited the houses at which the four cases of suspicious illness had occurred. The house in which Case I. occurred is one of four very dirty and dilapidated houses; the ground around these houses is unpaved and damp,—there is no drainage except by an open channel. The house itself was very dirty and the walls covered with dirt. The excreta had been thrown into a privy midden which was uncovered and contained a quantity of liquid filth. The bedclothes and clothes of the patient had been burnt, but the privy had not been emptied, nor any other measures taken.

Case No. II. occurred in one of a row of houses which are fairly clean; the drains were defective, with old bell traps; and there was a row of offensive privies eight yards away. The bedclothes of this patient had been burnt, but the nightdress and clothing had been washed at home. The privy midden had not been emptied nor any other measures taken.

Cases III. and IV. occurred in a house which was fairly clean inside, but damp, the drains were defective and caused marked nuisance, the gulleys not being trapped properly. There were two privies at the back of the house, one of them being only a yard away from it, and a large ashpit. The privy nearest the house was used by two households, and was of the tub, or pail, pattern, but the pail was not large enough, and the filth was said to overflow into the yard. Two yards away from the privies and ashpit is a bakehouse, the window of which faces them. The privies are frequently used by strangers who pass through the yard. The privy at this house had been emptied on the morning of my visit, but no further measures taken. I found on inquiry that there were no other cases of diarrhœa present in either of the before-mentioned households. I also found that all the households in which cases of choleraic illness had occurred used the town water and no other. The patients had not taken any fish or shell-fish recently, nor could I find any evidence of communication between them and any places where cholera had occurred.

The bodies of the two fatal cases had been wrapped in sheets dipped in a solution of carbolic acid and were buried in the cemeteries.

Excrement disposal in the town is effected chiefly by privy middens, and also by tub or pail closets. There were very large accumulations of filth in the privy middens at the time of my visit.

The water-supply of the town is obtained from the Nutbrook Canal, the Nutbrook, and the water pumped from disused coal "workings." The Nutbrook Canal falls into the River Trent. The water in the Nutbrook is obviously polluted by sewage. The Medical Officer of Health informs me that the Nutbrook is polluted by sewage from Heanor and Marpole, and is joined above the intake by the Stanley Brook, which receives both excremental pollution and house drainage. The water from these three sources is collected in a reservoir, and passed through filters of sand and gravel before being pumped into the mains. At the time of my visit nightsoil was being unloaded on the banks of the canal, and a quantity of it was entering the water. This nightsoil is brought in barges from Nottingham and other places. The surface of the filter-beds is "scraped" about once in ten days; the material of the beds appeared in September last not to have been changed for at least twelve months. Six cases of enteric fever had been notified in July, nine in August, and eight in September during the present year. I subsequently conferred with the Mayor, the Chairman of the Sanitary Committee of the Town Council, and the officers of the Sanitary Authority, and advised as to the necessary precautionary measures to be taken.

No. 13.

App. A. No. 13. On a fatal case of Cholera in Fulham Workhouse; by Dr. Copeman.

REPORT on the Circumstances attending the DEATH from CHOLERA of an Inmate of the FULHAM WORKHOUSE; by Dr. S. MONCKTON COPEMAN.

A. B., female, aged 51, died at 4.30 a.m. on Monday, September 11th, 1893, in the infirmary of the Fulham Workhouse. Cause of death certified by Dr. Steer, the medical superintendent, as due to "Choleraic Diarrhœa."

On visiting the infirmary on the following day (September 12th), in accordance with instructions, I obtained the following particulars of the case:—

Clinical Symptoms.—From a pauper attendant I learnt that A. B. had apparently been in good health up to the morning of Sunday, September 10th, and had made no complaint of pain or diarrhœa previous to that date. The attendant referred to, who had worked in the ward in which A. B. used to sleep, further stated that the deceased woman got up about 6 a.m. on Sunday morning and dressed herself as usual without making any complaint. She breakfasted at 6.30 a.m. (bread, butter, and tea), but about 8.30 said that she felt sick and went to the watercloset attached to the laundry, where she vomited. She had no motion of the bowels at that time. She attended chapel at 10.30, and although she afterwards said that she had "felt bad," she did not go out during the service. Just previous to dinner at 12.15 she had another attack of vomiting. She had dinner in the hall (beef, bread, and potatoes), which she disposed of without apparent inconvenience. Shortly after dinner, according to Nurse Cole, an aunt of A. B.'s (who lives in one of the "cottages" for old married paupers) came to fetch her niece for a visit. A. B. had been there about an hour when her aunt requested Nurse Cole to go to the cottages, as she thought her niece was dying. Upon arrival there the nurse found A. B. lying apparently insensible in an armchair, and learnt that she had been attacked with vomiting and purging, and had made use of the "cottage" watercloset. Dr. Steer was then summoned, who ordered A. B. to be taken to the infirmary.

(From Dr. Steer I learnt that A. B., who was an able-bodied but weak-minded woman, had on one or two occasions previously been attacked with fainting fits.)

She had regained her senses before she was actually removed from the cottages to the ward, and on arrival in the ward about 3.30 p.m. she is said by the ward nurse to have looked cold and blue, but she made no special complaint of pain. About 4 p.m. A. B. had an attack of diarrhœa, but as, in the temporary absence of the nurse, she made use of the watercloset the nature of the stools was not ascertained. While in the closet she nearly fainted, and so was speedily got back into bed, when she was given some brandy and water, and hot-water tins were placed at her feet. Dr. Steer also ordered for her some bismuth and opium mixture.

Shortly after the doctor had left the ward the patient complained of cramps in her legs, which were rubbed by the nurse. This pain continued with intermissions throughout the night, and there was also some pain in the stomach.

Prior to 7.30 p.m. she had vomited twice, the material which was brought up looking, according to the nurse, like a mixture of curdled milk and undigested food. Several hours later she vomited once more,

the vomit at that time being plentiful and resembling weak milk and water.

Her bowels were opened twice between 8 p.m. and midnight, after which she was purged at intervals of about five minutes or less between this time and 2 a.m., after which till 4.30 a.m., when she died, the purging almost entirely ceased. The motions, according to the nurse, resembled "water above with soft white flakes below."

When first admitted to the ward an attempt was made to take her temperature, but in vain. The thermometer used registered down to 95° F., above which the mercury could not be induced to move. It was therefore shaken down almost into the bulb, but again it had not appreciably moved after an interval of several minutes. About 9 p.m. the temperature had risen to 97·4° F., and shortly after death it was noticed that the body seemed very hot, but the temperature was not taken.

Post-mortem appearances.—A post-mortem examination was carried out about 10 hours after death by Dr. Steer. Dr. Shadwell of the Metropolitan Asylums Board was also present.

The features were pinched, the eyes shrunken, the lips and hands blue. The stomach, which contained a few ounces of fluid material, was removed for purposes of analysis, if such a course should subsequently be deemed advisable. The small intestine was injected in its whole length, its mucous surface being covered with a brown grumous material like altered blood. The large intestine was not so injected, and contained a semi-fluid material of lighter colour than in the small intestine. The gall bladder was full of stones. The urinary bladder was collapsed and empty.

Portions of the ileum and colon were sent to Dr. Klein for microscopical and bacteriological examination. He subsequently reported that the comma bacilli were present in quantity, and that a pure growth gave the typical cholera-red reaction.

Movements of A. B. antecedent to attack.—With regard to the previous movements of A. B. I learnt, from the master of the workhouse, that since December 7th, 1891, she had never been outside the house, and that from that time to the date of her attack she had never been known to have a visitor. Her only relatives besides her husband were apparently an old uncle and aunt living in the "cottages" attached to the house, of whom the former was suffering from senile dementia. Her husband was also in the workhouse, although in a different ward, and had not seen her for several months. She had occasionally seen her uncle and aunt, but as no one is known to have supplied them with money it is highly improbable that she could have obtained anything from them in the way of food or drink. Being able-bodied, her diet had been that of the other inmates of the house. Water was supplied from the mains of the West Middlesex Company. A. B. worked in the laundry, where the clothes of patients in the infirmary were washed. None of these, however, had recently suffered from disease of a similar character.

Action taken as to Notification, Disinfection, &c.—On the death of the patient, Dr. Steer notified the case as one of "choleraic diarrhœa," to Dr. Hill, who at the time was temporarily doing duty for Dr. Jackson, the Medical Officer of Health for Fulham, at the same time informing him as to the extremely suspicious nature of the illness. He also informed the Coroner, who ordered a post-mortem examination to be made and an inquest to be held.

With regard to disinfection, Dr. Steer informed me that, at his request, the master of the workhouse had ordered all clothing and

App. A. No. 1.

On a fatal case of Cholera in Fulham Work house; by Dr. Copeman.

bedding which had been used by A. B. while in the house to be burnt, and that this had been done; also that all the remaining bedding used in the infirmary by A. B. had been soaked in a solution (1–1,000) of perchloride of mercury, and the small ward in which she was treated had been fumigated with sulphur. I further learnt that the bedding had been destroyed by fire.

I advised that further steps should be taken, which should include the scrubbing of the floor of the workhouse ward and of the small ward at the infirmary with solution of perchloride of mercury, as also the seats and floors of all the water closets A. B. could have used, and that the drains should be well flushed out with a large quantity of a similar solution.

No. 14.

Report upon a limited but extremely fatal Outbreak of Cholera which occurred in the North Bierley Urban Sanitary District; by Dr. H. Timbrell Bulstrode.

On October 5th, 1893, a communication was received by the Board from Dr. Logan, the Medical Officer of Health for the above district, stating that "An intensely virulent form of 'Choleraic Diarrhœa,' or "'English Cholera' has manifested itself, and been in progress for "fully ten days, causing the death of five people. The disease has "been characterised by severe choleraic symptoms from the commence-"ment in each case; in three, terminating in collapse and death in "from nine to twelve hours, in one, in two and a half days, and in the "other, after the lapse of about ten days."

"All who were attacked died (and being related, had more or less "attended on one another during their illnesses), with the exception of "one woman who is apparently suffering from an ordinary attack of "diarrhœa, and who is likely to recover."

Upon the receipt of this communication, a telegram was immediately despatched to Dr. Logan, requesting that, if possible, a small portion of the ileum of one of the fatal cases should be forwarded to Dr. Klein for bacteriological examination. Dr. Logan was also informed that a Medical Inspector would at once proceed to North Bierley to confer with him upon the subject of the outbreak. Acting upon instructions, I proceeded the same night to Bradford, and on arriving there discovered that the occurrence had already excited considerable attention. Early next morning I visited Dr. Logan at North Bierley; and from him, as also from Dr. Naylor, and other sources, I obtained the following particulars:—

The first patient to be attacked was E. W., a youth aged 20, who was by trade a fitter at the local railway works. He was said to have been a phthisical subject, and to have suffered for several months past from diarrhœa, probably tubercular in origin. Owing to the poor condition of his health he had, under medical advice, been recently staying at Southport, but on Monday, September 18th, he returned home. He seems at this time to have suffered from diarrhœa in a somewhat aggravated form, but owing to the fact that he was subject to attacks of this nature, but little moment was attached to it by his mother. However, on the night of Sunday, September 24th, she called on Dr. Naylor (the boy's medical adviser), and requested a dose of the mixture which by experience had proved efficacious in former attacks. The usual improvement did not, however, follow the administration of the medicine, and on Tuesday, September 26th, Dr. Naylor was asked to visit the boy. On doing this he found him in bed, in a state of collapse, with feeble, fluttering pulse, cold extremities, sunken eyes, weak voice, cramps in legs, temperature 95°, and passing rice water stools. Vomiting subsequently set in, at first coloured with bile, but afterwards clear and watery, the pulse disappeared from the wrist, the extremities became blue and cold, the abdomen was retracted, and the urine scanty. This condition of collapse continued for about three days, but at the end of that time the pulse began gradually to assert itself at the wrist, the body became warmer, the temperature rose two degrees, and the urine became re-established. Subsequently, however, due not unlikely to deprivation and neglect, the patient passed into a condition resembling

that of "cholera typhoid," and died in collapse on Tuesday, October 3rd. It was from this case that the piece of ileum was forwarded to Dr. Klein. At the autopsy opportunity only afforded a glimpse of the internal appearance of the intestine to be obtained, and it was described to me as presenting an injected and almost gangrenous aspect. Death was certified as due to (*a*) "Choleraic Diarrhœa"; (*b*) collapse and exhaustion.

Dr. Klein subsequently reported as to this case that the microscopical appearance was very suspicious, but that he had been unable to obtain the culture reactions of the comma bacillus. In reference to this, it may be added that the patient from whom the specimen was taken had been ill about ten days, and that the stage of reaction had intervened between the primary collapse and death. (*See* Dr. Klein's report, App. B., page 185.)

As far as the evidence goes, it was E. W. who was instrumental in either a direct or indirect manner in causing the other attacks now to be described. The family of which he was a member had been for some time prior to the outbreak in a condition of great destitution, owing to the commercial complications then prevalent in the district. It would seem in fact from the narratives I heard that they were more or less destitute of the bare necessities of life, and it was only after the father and mother had contracted and succumbed to the disease that the attention of the Sanitary Authority was called to the condition of the household, and public sympathy awakened in its favour. Even when the nature of the disease was suspected the terror of it was so great that the patients were for some time left in the care of a daughter aged 20, who was at Leeds at the date of my visit. The Sanitary Authority eventually sent in a "nurse," but I was informed on good authority that she was frequently discovered either asleep or inebriated. The above facts are of some importance as bearing upon the unique fatality of the outbreak.

The house in which the W. family lived was in no way remarkable as to its sanitary condition, and there was no overcrowding of houses in the neighbourhood. In the W.'s house, as also very generally throughout the district, excrement disposal was effected by means of privy middens. The water supply for the district was from the Bradford Corporation Waterworks. It should, too, be added that the several houses invaded were separated by considerable distances, and there was no connexion between them in the matter of drainage or excrement disposal.

M.W., aged 42. (Mother of E. W.)—Death certified as due to "choleraic diarrhœa." Mrs. W., who was nursing her son, was apparently in good health on the morning of September 26th. At noon, however, she was attacked with diarrhœa, cramps in her legs, and vomiting; her temperature was 94°. At three p.m. she was in a state of profound collapse, with sunken eyes, weak voice, and cold extremities. The collapse increased, and she died at 11 p.m. the same evening. In this case, as also in those next referred to, the condition of the patient precluded any accurate observations being made as to suppression of urine.

In this case it is obviously impossible to fix the limit of incubation of the disease, as the evidence before us does not suffice to show at what period E. W.'s discharges became specifically infective, or when Mrs. W. reacted to them. All one can say is that there is a probability, almost amounting to certainty, that the mother derived her attack from her son rather than from a common cause with him.

Mrs. L. (1), aged 47. (Sister of Mrs. W.)—Death certified as due to "choleraic diarrhœa." Mrs. L. had visited Mrs. W. during her illness and also assisted in preparing her for burial. At 8 p.m. September 28th, Dr. Naylor was called to Mrs. L., and on visiting her house discovered her to be in a condition of collapse, with a temperature of 94°. Her general state was described by Dr. Naylor as exactly resembling that of her sister Mrs. W. The patient's condition got gradually worse and she died at 5 a.m. September 29th.

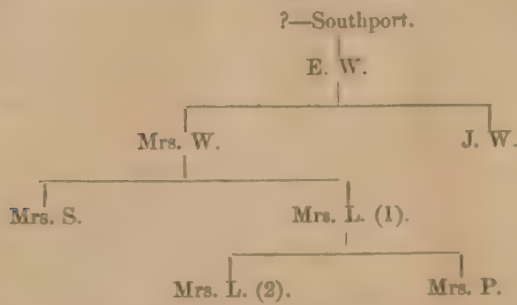
J. W., aged 42. (Father of E.W.)—Death certified as due to "choleraic diarrhœa." Mr. W., who had aided in nursing his son and presumably also his wife, was seized on the night of Thursday September 28th with diarrhœa, vomiting, and violent cramps. His voice subsequently became weak, his eyes sunken, and his skin sallow. He appears on Friday night to have rallied a little and to have maintained the improvement for some time. Collapse, however, set in again and he died on Sunday, October 1st.

Mrs. S. aged 41. (Sister of Mrs. W.)—Death certified as due to "cholera (English)." Mrs. S. had visited Mrs. W. during her illness and also assisted to "lay her out." She was apparently quite well up to the night of Tuesday (September 26th), when she went to visit Mrs. W., who was then ill. Next day (September 27th) she was, however, affected with diarrhœa, which continued onand off, but which did not entirely incapacitate her until the early morning of Monday, October 2nd, when she complained that her motions "were running away like water." She was at the same time attacked with vomiting, and the vomit was apparently of the same appearance as the motions. Subsequently cramps in her legs set in, her extremities became cold, and she died at noon Monday, October 2nd.

Mrs. L. (2), aged 72.—The patient had visited Mrs. W. and had also nursed Mrs. L. (1). Mrs. L. (2) visited Mrs. W. on September 26th, and on October 1st was taken ill with diarrhœa, the motions being "like thick beer." She, however, kept about until the following Thursday, October 5th, when the diarrhœa became worse, and vomiting and cramps supervened. I saw this patient on Friday, October 6th, at which time she was lying on her back in the bed in a collapsed condition, with a feeble pulse, sunken eyes, and cold extremities. I was unable to obtain at that time a sample of the motions, but I left with the medical attendant a wide-mouthed bottle, properly prepared, and requested that he would forward either a sample of the motions or a piece of the ileum according as to the opportunities which developed. He kindly forwarded a sample of the motions to Dr. Klein, who detected the comma bacillus by microscopical examination, and subsequently demonstrated its presence by means of cultivations. (*See* Dr. Klein's report, Appendix B., page 185.) Mrs. L. died on October 9th, her death being certified as due to "cholera."

Mrs. P., aged 66.—Mrs. P. assisted in "laying out" Mrs. L. (1). She was quite well until Sunday, October 1st, when she had pain in her abdomen and diarrhœa. On Thursday, October 4th, Dr. Naylor was called in to see Mrs. P., and visiting her found that she was afflicted with vomiting and diarrhœa, the stools, however, were semi-solid and light in colour. On Friday Mrs. P. was better, though the vomiting still continued. There was then no sign of collapse about her. Dr. Naylor wsa good enough to subsequently inform me that this patient rapidly recovered.

Diagram showing what was apparently the relation of the cases to one another.



It is of course quite possible that Mrs. S. and Mrs. L. (1) derived infection from E. W., who, it will be borne in mind, was a patient during the whole time Mr. J. W. and Mrs. W. were ill.

The origin of E. W.'s attack it was not possible to determine, more especially as those who could have afforded the most reliable information had all fallen victims to the outbreak. The girl who nursed the W.'s had, as already stated, at the time of my visit left the district, so that the evidence had to be culled to a large extent from second hand channels. It may be said that there was no evidence pointing to this outbreak having been caused by specifically polluted water, or by the ingestion of any food, or poison other than cholera, and indeed the history of the outbreak is far better explained upon an hypothesis of a highly infective diarrhœa of that class in which cholera is included than by any other.

Clinically, the symptoms were, in nearly every case not to be distinguished from true cholera, and it will have been seen that in the case of Mrs. L. (2) Dr. Klein was able to demonstrate, both by microscopical examination and by means of cultivation, the presence of the comma bacillus. In regard to case mortality this outbreak would compare with the most fatal of Asiatic cholera; but in judging of the nature of the complaint from this standpoint, the markedly depressing circumstances in which this neighbourhood, and especially the W. family, was at the time must be kept in view. Having regard to all the circumstances of the case it would appear that the only thing necessary to explain the outbreak upon a thesis of true cholera is that of its origin. Here, however, all attempts at solution were unavailing. There had been, it may be added, within two months of my visit some deaths of adults in the district from "cholera nostras" and "choleraic diarrhœa," but I was unable to trace any connexion between them and the cases under consideration.

* * * * * *

October 10th, 1893.

No. 15.

Report upon an Outbreak of Cholera at Tividale in the Rowley Regis Urban Sanitary District; by Dr. R. Deane Sweeting.

In obedience to instructions, I proceeded on September 26th, 1893, to Rowley Regis. I met that evening Dr. Beasley, the Medical Officer of Health to the Local Board, and Dr. Reid, the County Health Officer of Stafford. With them I visited some of the houses where reported cholera had occurred, and made some preliminary inquiries, which were further extended the next day.

Prior to my visit there had been in all six cases, two of them fatal. All had occurred in Tividale, (population, 1,697), an outlying colliery hamlet of the parish of Rowley Regis, adjacent to Tipton; five of them in one street, Lower Chapel Street, the other in Brown Lion Row some 40 yards away

The first case (*a*) was M. S. (æt. 60), wife of a watchman in Lower Chapel Street, who was subject to "stomach-ache" and diarrhœa, and who was easily upset by food. She was seized suddenly on Saturday morning, September 23rd, at 9 a.m. with vomiting and purging, cramps in the legs and stomach. Both vomit and stools were said to be dark and the latter watery. The medical man who saw her that evening found her almost pulseless, the extremities cold, the surface of the body blue, and she was suffering from intense cramps in the legs and abdomen. The skin was shrivelled, the eyes sunken, and there was well-marked "Vox cholerica." No stools were seen by the doctor, but the vomited matters were dark green and watery. She died at 1. 30 p.m. on Sunday (24th) after 23 hours' illness.

The next case (*b*) was A. T. (æt. 60), wife of a colliery labourer in Lower Chapel Street. She was attacked on Saturday night, September 23rd, at 9 p.m. with light-headedness, pain in the belly, cramps, vomiting, and purging. The diarrhœa was very profuse and watery, and lasted, along with the cramps and vomiting, until 5 a.m. on the 24th, when it ceased for a time. On Monday the 25th she was again purged twice. The stools were said to have been dark and watery; but none were seen by the medical attendant. This patient at the time of my visit was recovering, though still in bed on September 27th when I saw her.

The next case (*c*) was C. B. (æt. 47), the wife of a brickworker living in Brown Lion Row. She was subject to epileptiform fits. On Sunday afternoon, September 24th, about 4 p.m. she was suddenly taken with violent vomiting and purging, cramps (beginning in the feet and legs and passing up to the belly and arms), and blueness of the hands. The stools were noticed to be at first dark green, but afterwards much lighter. The medical man who saw her at 2.45 a.m. on the 25th found her in much the same state of collapse that he had found case (*a*). Here also there were marked cramps and "Vox cholerica." No vomit or stools were seen by me, but the former was stated to have been excessive in quantity, and the latter green in colour. C. B. died at 1.30 on Monday afternoon (25th) after about 21 hours' illness.

A portion of the intestine of this woman was sent to Dr. Klein who, after a bacteriological examination, was unable to distinguish the case from true cholera.

The next case (*d*) was W. H. M. (æt. 19), a colliery labourer, living in Lower Chapel Street. He was taken ill at midnight on Sunday September 24th whilst at work at the Pit Bank, with "violent pain in

the inside" and vomiting; purging set in, which continued all the night. He left work at 9 a.m. on Monday (September 25th), using a privy on his way home. The vomiting and diarrhœa continued all day Monday, until the evening. The motions were light and watery at first, slimy and dark afterwards. No flakes were noticed in them. There was no lividity in this case, and slight cramps supervened only after the cessation of the diarrhœa, viz, on Tuesday, September 26th. This young man at the time of my visit was downstairs and recovering.

The next case (*e*) was Mrs. B. (æt. 30), wife of a colliery labourer, living in Lower Chapel Street. She was suddenly attacked at 2 a.m. on Monday, September 25th, with purging, vomiting, pain in the belly, cramps in the belly and the legs. The stools were noticed by her to be light coloured and "yeasty." Dr. Beasley, who attended the case, speaks of them as being "the colour of mustard and the consistence of thin gruel." The last motion before my visit to her on the evening of the 26th was semi-solid. She was downstairs and convalescent on the 27th, though there had been some recurrence of loose motions that morning.

The last case of the series (*f*) occurred in a boy, N. S. (æt. 6 years), living in Lower Chapel Street. He is subject to diarrhœa, and has had frequent attacks of it. On Monday morning, September 25th, at 7 a.m., he was suddenly seized with severe purging and vomiting, which lasted until until 4 p.m. that day. There was headache and also some pain in the belly, but no cramps. The first two or three stools were noticed by the mother to be dark and slimy ("mud-like"); but they afterwards became lighter. He had apparently quite recovered at my visit, for his mother had sent him to school on the morning of the 27th.

The dejecta of all six cases had been thrown as soon as passed into the midden privy of the yard in which each occurred.

Though five of the six cases reported upon occurred in Lower Chapel Street, they were in four separate though contiguous yards of that street. With one exception, the houses invaded in the street were fairly clean and not overcrowded. The exception was a dirty, damp, dwelling containing three families in four rooms. All the four yards, however, exhibited seriously unwholesome conditions, such as unpaved and damp ground, open surface channels conveying slop-water to a foul ditch at the back of the street, overfull middens, and inadequate privy accommodation. As regards water, three of the houses were supplied with tap water from the South Staffordshire mains; one with this and with deep well water; the other with deep well water only. The deep wells mentioned (two in number) are but loosely steined. I saw signs of surface percolation into one of them, viz., that used by case(*f*). There had been two cases of (unreported) diarrhœa in the same yard as (*f*) about a month before, one of them attended by cramps.

Brown Lion Row (where Case *c* died) is one of the worst properties in the district. It is built up to within four feet of the bank of the Birmingham Canal, the interval being filled up with solid accumulation of old rubbish, which is close against the pantry windows of the houses in the row. The foundations of the houses are 10 feet below the top of the canal bank, the back of which is formed by loosely placed "cinder slag." The back walls of all these houses are damp; the flooring consists of broken bricks and earth; the roofing is defective, leading to the incursion of rain. Privy accommodation is inadequate, and a large but roofed midden, serving seven houses, is built up close to the end house of the row. Drainage is effected by open, often broken, surface channels in front of the houses, leading to untrapped gullies and grids, from

which the sewage is conveyed by a pipe under the road to a ditch in the field opposite.

Water is supplied to the houses in this row from a standpipe led from the South Staffordshire Company's mains.

The close connexion in time, as well as place, of these six cases is noteworthy. All six were attacked between 9 a.m. on Saturday, September 23rd, and 7 a.m. on Monday, September 25th, *i.e.*, within 46 hours. This, along with their proximity to each other, would seem to suggest some common and rapidly acting cause. I could get no evidence of importation from or of human communication with the places already known to be infected with true cholera. I made particular inquiry as to this with regard to places near by such as Derby, Leicester, Ashbourne, Mansfield, and Ilkeston, as well as ports of Hull, Grimsby, and Cleethorpes. Case (*d*) had partaken of some mussels at a fishmongers shop at Dudley on Saturday night, the 23rd. On inquiry at this shop I found that the fishmonger obtained his mussels from two salesmen in the Birmingham Market. I inquired there also, and found that mussels are usually obtained by them from Wales and from Holland. The "Dutch mussels" (of which I saw many exhibited for sale as such) come ordinarily by boat from Rotterdam to Hull and sometimes to Grimsby, and thence by rail to Birmingham. Occasionally they come *viâ* Harwich.

These and other salesmen in Birmingham fish market acquainted me with the fact that a great deal of their fish came from Hull and Grimsby; and that they were in the daily habit of selling it to small dealers who came in from the towns around. I learned that fish-hawkers frequented Lower Chapel Street and other parts of Tividale almost daily, and I saw one in the invaded street at my visit. It is a fact, too, that Cases (*b*), (*e*) and (*f*) (in Lower Chapel Street) had partaken of fish purchased from such hawkers a few days before their respective attacks, whilst Case (*c*) had not eaten any, except on one occasion ten days before. This was purchased from a small dealer in Oldbury who procured it from Birmingham. Case (*a*) had taken neither mussels nor fish.

Case (*d*) had recently returned from hop-picking in Herefordshire, and Case (*e*) from hop-picking in Worcestershire. The latter was said since his return to have eaten a great many apples that he brought with him.

None of the cases had been removed to an isolation hospital. The Authority possess one; but it was occupied by small-pox. Neither had the bodies of the fatal cases been removed to the public mortuary of the district, the reason alleged being that they were not known definitely to be cholera.

The midden at Brown Lion Row had been emptied and sprinkled with carbolic powder. The house in Lower Chapel Street where the fatal case had occurred was being disinfected by sulphur fumigation and washing with carbolic solution at the time of my visit. All evacuations from the patients were mixed with carbolic powder supplied by the Authority after the cases became known to them. I suggested that the bedding of the two fatal cases should be at once burnt, and this was done.

On September 27th, I attended a specially summoned meeting of the Local Board, and advised the Sanitary Authority as to the necessary precautions to be taken.

App. A. No. 15.

On Cholera at Tividale by Dr. Sweeting.

Additional Note by Dr. Sweeting with regard to the Outbreak at Tividale.

I paid a second visit to Tividale on September 29th, when I was made aware by Dr. Beasley, the Medical Officer of Health, of two fresh cases of suspected cholera at Tividale. They had both occurred in Brown Lion Row, where C. B. had died on September 25th.

The first case was A. R. M. (æt. 31), the wife of a brickworker, living a few doors from C. B.'s cottage. She was attacked on the morning of September 27th with headache, vomiting, diarrhœa, and some pain in the belly. She had no cramps and no blueness of the hands or feet or any other part of the body. The motions, when viewed by Dr. Beasley on the 28th, were light yellow in colour, and in consistence like gruel. The diarrhœa continued all that day, but the other symptoms gradually abated. When I saw her at 2 p.m., on the 29th, she was lying on the sofa downstairs. The motions were becoming more solid; but she had still some pain in the belly and felt sick.

I found that A. R. M. had been on intimate terms with C. B., and had run in and out of her cottage during the latter's illness. Further, A. R. M.'s mother, living next door, and frequently visiting her, had helped to lay C. B. out.

The second case was T. B. (æt. 5), son of C. B., and living in the same house. He was attacked on Wednesday night (27th) with vomiting, purging, and great pain in the bowels. He apparently had no cramps or lividity. Recovery was rapid, for when I saw him shortly after 2 p.m., on the 29th, he was sitting dressed in the downstairs room of the house to which he had been removed. Neither his stools nor vomit were seen by Dr. Beasley.

Bearing in mind their close connexion with C. B., it seems fair to assume that these two cases derived their infection directly or indirectly from her.

The cottage where C. B. died has been already described, that occupied by A. R. M. has similar accommodation, but is cleaner, less damp, is not built up to the bank of the Birmingham Canal, and there is more free air space at the back.

* * * *

No 16.

Report upon Two Deaths due to "Cholera" at Coton Hill Private Asylum, Stafford; by Dr. H. Timbrell Bulstrode.

In consequence of a telegram received on October 2nd, from Dr. George Reid, consulting physician to the Coton Hill Asylum, and Medical Officer of Health to the County Council of Staffordshire, that two deaths of a suspicious character had occurred at that Asylum; and in view of the fact that a microscopical examination of the intestinal contents of one case had been pronounced by Dr. Klein distinctive of cholera, I was instructed to proceed to Stafford and inquire into the circumstances of the case. I arrived at Stafford on the night of October 2nd, and on October 3rd had an interview with Dr. Reid, and Dr. Blumer, the Medical Officer of Health for Stafford Rural Sanitary District, in which the asylum in question is situated. From these gentlemen and from the Medical Superintendent of the asylum I learnt the following particulars:

The Coton Hill Asylum is situated on a well-elevated site of red marl, about 1½ miles from the centre of Stafford, and about 400 yards from the borough boundary. It contains some 136 paying patients.

Case No. 1 was that of a male aged 52, who had for the last 30 years been an inmate of the asylum. He was of a debilitated constitution, and was demented. On Tuesday, September 26th, at about 4.30 a.m., he was, without any "premonitory" diarrhœa, taken suddenly ill with vomiting and diarrhœa. At 8 a.m. he was in a state of collapse, but conscious, with cold clammy skin, pinched features, and cold extremities, pulse only just perceptible. The patient seemed also to have drawn up his knees, as if suffering from abdominal pain. His condition got gradually worse, in spite of stimulants and opiates, and he died at 9.40 p.m. the same day. The stools were described as having been at first "undigested food," but afterwards "clear and slimy." Those who saw them, including an old Indian servant who had seen many cases of cholera, did not regard them as "ricewater" in appearance. The vomit consisted, so I was informed, of "undigested food;" it was not bile stained. The temperature was sub-normal. At the autopsy it was stated that the intestines were distended, and that no ricewater contents were discovered. There was no sign of peritoneal inflammation. Peyer's patches were normal in appearance.

Case No. 2.—Male aged 56. Inmate of asylum for three years; feeble in health, a subject of chorea (but not taking arsenic), and "cerebro spinal sclerosis." Patient was in same ward as case No. 1.

This patient was taken ill with vomiting and diarrhœa between 5 and 6 p.m. on September 29th. The stools were yellow and fluid at first, but became more watery afterwards, and deposited a flocculent precipitate. The patient had apparently no cramp, and no pain after the first evacuation. The symptoms continued to increase in severity, and the patient died in collapse about 12.50 a.m. September 30th, after eight hours' illness.

At the post-mortem the intestines were stated to be collapsed against the vertebral column, and the bladder distended up to the level of the umbilicus. No other appearances seem to have attracted the notice of

the pathologists. It was from this case that a part of the ileum was sent by Dr. Reid to Dr. Klein. [Dr. Klein's investigations (see page 184) gave, both microscopically and culturally, positive evidence of true cholera.]

As regards the etiology of the two cases, it may be said that as both occurred in the same ward, and the interval between them was but short, it is not improbable that the second case was dependent upon the first, though no evidence was forthcoming on this point. Assuming, however, for the sake of investigation, that Case No. 2 bore no causal relation to Case No. 1, and that each was due to an independent, or to a common cause, it was not possible to establish the origin either of the one or the other.

As regards communication with any pre-existing case, either inside or outside the asylum, I was unable—as also were the medical men concerned in the inquiry—to obtain any clue. I inquired as to the visits of friends, the sending in of food, &c. to them, the visits of the attendants to towns infected with cholera, the source, as far as possible of all solid or liquid foods arriving in the asylum, more especially fish, tinned meats, milk, water; fruit, &c. As regards fruit, it may be mentioned that all the patients had eaten pears grown on the estate; but they appear to have been sound and not to have been indulged in inordinately. The fish to the asylum had previous to September 8th come from Grimsby, but all had been boiled and no shell fish had been eaten. I was unable to ascertain from the medical superintendent that there had been any cases antecedent to those under review, at all suspicious of cholera.

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No. 17.

ORDERS issued by the LOCAL GOVERNMENT BOARD on September 1st and 6th, 1893, putting in force EPIDEMIC REGULATIONS in respect of CHOLERA in GRIMSBY and CLEETHORPE SANITARY DISTRICTS.

I.

To the Urban Sanitary Authorities of Grimsby and Cleethorpe-with-Thrunscoe, and the Port Sanitary Authority of Grimsby;—
And to all others whom it may concern.

Whereas the Urban Sanitary Districts of Grimsby and Cleethorpe-with-Thrunscoe and the Port Sanitary District of Grimsby are now threatened with Cholera, We, the Local Government Board, in exercise of the powers given Us by the Public Health Acts, and any other Acts enabling Us in this behalf, do by this Our Order make the following Regulations, and declare the same to be in force in the said Urban Sanitary Districts and Port Sanitary District, and to apply to any vessels within the jurisdiction of the said Port Sanitary Authority.

In this Order the following terms shall, unless the contrary intention appears, have the meanings hereby respectively assigned to them; namely,—

The term "Local Authority" means Urban or Port Sanitary Authority of the said Districts.
The term "district" means the district of such Authority.
The term "house" includes any ship or boat.
The term "cholera" includes choleraic diarrhœa.
The term "guardians" means a board of guardians elected under the Poor Law Amendment Act, 1834, and the Acts amending the same, and includes a board of guardians or any other body of persons performing under any Local Act of Parliament, the like functions to a board of guardians under the Poor Law Amendment Act, 1834.

The Local Authority shall forthwith make arrangements for meeting daily, or, according to the exigencies of the district, shall appoint one or more committees of their body to meet daily, for the purpose of carrying the following regulations into effect, and shall see that the same are carried into effect so far as circumstances require. Each committee so appointed shall have all such powers of the Local Authority within the part of the district, or in relation to the special matters entrusted to them (including the power of incurring expenses and of appointing officers and of taking legal proceedings, but not the power of levying rates or borrowing money), as may be necessary for the purposes of these regulations; and in the followlng regulations the term Local Authority shall include any such committee:—

1. The Medical Officer of Health shall advise the Local Authority on all matters concerning the carrying these regulations into effect, and shall generally superintend the carrying out of the same.
2. In each district, or, if the quanity of work to be done renders it desirable to sub-divide the district, then in each of such sub-divisions, a legally qualified medical practitioner, herein-

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after called the medical visitor, shall be put in charge of the district or sub-division for the purposes of these regulations under the superintendence of the Medical Officer of Health, and each such medical visitor shall be provided with all needful medical assistants and such other assistants as may be required for carrying these regulations into effect: Provided that every Poor Law District Medical Officer who shall not be appointed a medical visitor shall, *ex-officio*, be a medical assistant for his district or for so much thereof as is within the district of the Local Authority, and he shall be entitled to reasonable payment from the Local Authority for his services.

3. The medical visitor, or one of his assistants, shall, at least once daily, visit those parts of the district or sub-division which are inhabited by the poorer classes, or wherein the disease is present, and shall there inquire at every house as to the existence of cholera or diarrhœa, and shall enter in a report book to be kept by him for the purpose the facts as to all cases he may meet with; and shall, without delay, give, or take the proper steps for causing to be given, all necessary medical assistance to the sick. The medical visitor or assistant shall, when visiting the part assigned to him, be provided with medicines for immediate administration in urgent cases, and shall be held to be in medical charge (which shall include giving directions as to preventing the spread of the disease) of all cases of cholera or diarrhœa with which he may meet, unless or until other provision for their medical attendance be made. He shall also, so far as possible, when visiting such part, investigate whether any conditions dangerous to health exist therein, and in particular whether there is any accumulation of excremental or other filth, and whether any unwholesome water supply is in use.
4. Each medical visitor shall, by transmitting the report books kept by him and his assistants, or in some other way, report daily to the Medical Officer of Health, for the information of the Local Authority, the result of his own and his assistants' inquiries with respect to cases of the disease; and shall also report all unwholesome conditions which he or any of his assistants may have discovered, and shall make such other suggestions as to the state of the district or sub-division as he shall deem advisable.
5. Immediately on the receipt of any such report from a medical visitor, the Local Authority shall see to all unwholesome conditions mentioned therein being remedied, so far as possible: such measures of cleansing and limewashing as cannot otherwise be speedily effected being carried out at the cost of the Local Authority by persons employed by them; and the provisions of the Public Health Acts being put in exercise as regards other matters that can be dealt with thereunder; or as regards matters which are under the control of some other authority, notice being given to the person or body having power to deal with the same.
6. Each medical visitor shall, where needful for the purposes of these regulations, communicate to the relieving officer any case of destitution requiring relief of which he may have become aware.
7. The Local Authority shall, under the advice of the Medical Officer of Health, provide a sufficient number of dispensaries to be open night and day, at convenient places within the district,

with an adequate supply of such medicines, medical appliances, and disinfectants as the Medical Officer of Health shall recommend, and with a legally qualified medical practitioner or skilled assistant always in attendance at each; and such medicines, medical appliances, and disinfectants shall be dispensed without charge by such medical practitioner or assistant to persons bringing orders for the same from a medical visitor or his assistant, and to any other persons who need immediate medical treatment and by or on behalf of whom application may be made for the same. The names and addresses of all such other persons shall be sent to the medical visitor of the place in which they reside.

8. In every case of cholera or diarrhœa, where the patient is not otherwise under medical care and treatment, the Local Authority shall, with the utmost expedition, cause medical assistance to be rendered, as well as provide such aid and comfort, nourishment and accommodation, as the circumstances of the case may require.
9. The Local Authority shall provide competent nurses to aid every medical visitor in his attendance upon the patients suffering from the disease.
10. If fit and proper hospital accommodation for patients has not already been provided, the Local Authority shall, with all practicable despatch, provide such accommodation, and cause the same to be provided with such furniture, appliances, medicines, and other things as may be required to render the same ready for use, together with the necessary ambulances and litters for conveying the sick, and shall appoint a legally qualified medical practitioner, with or without assistants, and with the requisite nurses and attendants, as the case may require, to attend to the same: Provided that the Local Authority and any other Local Authority, and the board of guardians of any union or separate parish may co-operate in providing hospital accommodation, maintenance, and treatment for cholera patients, and in removing such patients to hospital.
11. If the Medical Officer of Health reports that houses of refuge for healthy persons living in infected houses ought to be established for the district, the Local Authority shall, with as much despatch as practicable, provide such houses of refuge, and furnish them with all needful comforts and appliances, and place them when occupied under continuous medical observation. If they remove thereto any or all of the healthy persons living in an infected house they may, if necessary, provide for the maintenance of such persons therein.
12. If the Medical Officer of Health or a medical visitor reports that in any dwelling where there is a case of cholera the sick cannot be properly separated from the healthy, and that any person suffering from cholera should be removed to hospital, such person shall be removed accordingly to a hospital for cholera patients. If the Medical Officer of Health or the medical visitor recommends that the sick person or persons be not removed, but that the healthy be removed, the Local Authority shall forthwith cause them to be removed to a house of refuge or to such other sufficient accommodation as the Local Authority shall provide for them.
13. The Local Authority shall, for use in or about dwellings where cholera or diarrhœa exists, provide proper disinfectants in

sufficient quantities for the purpose of disinfecting the discharges from the sick, and the utensils and water-closets or other closets or privies in which such discharges may have been received, and for effecting any other disinfection proper to be done in or about such dwelling; and the medical visitor or assistant or other person in attendance on the sick, shall give full and particular instructions as to the best method of using such disinfectants and shall so far as practicable see to the same being so used.

14. The Local Authority shall provide proper means for removing for the purpose of disinfection and for disinfecting articles of clothing, bedding, or furniture, and shall cause every article of clothing, bedding, or furniture which shall have been exposed to choleraic infection to be disinfected; or shall cause the same to be forthwith destroyed; and shall within a reasonable time replace all such articles or pay the reasonable value to the owner.

15. Every Local Authority, company, or person owning or having possession of any waterworks for the public supply of water shall cause the sources of water supply, filter beds, reservoirs, cisterns, pipes, pumps, and other apparatus belonging thereto, to be carefully examined, cleansed, and purified, and other necessary measures to be taken, so that the water may be supplied without impurity. The Local Authority shall, at their first meeting after the receipt of this Order, direct a copy of this regulation to be sent to each such company or person supplying water within their district.

16. If it appear to the Local Authority that any drinking water used in the district is polluted, or is in immediate danger of becoming polluted, they shall at once (in order to provide for the immediate necessities of the consumers of such water) take measures to provide wholesome water in its stead, and to prevent, as far as possible, the further use of the existing supply. For this latter purpose the Local Authority may close any public or private wells and prevent the use of water from any particular source.

17. The Local Authority shall make due arrangements with undertakers and with the authorities of churchyards, burial grounds, and cemeteries, and otherwise, so that interment or other proper disposal of the body may speedily take place in the cases of deaths arising from cholera, and shall, when informed of any such death, cause the corpse to be disposed of with the utmost despatch, and with such precautions as the Medical Officer of Health shall deem necessary.

18. Where any death shall occur from cholera, no collection of persons shall assemble in the room where the corpse is, and no "waking" of the dead shall be allowed.

19. The Local Authority shall cause the immediate removal from any room which living persons inhabit, of the corpse of every person dying from cholera, and provide for the proper custody of such corpse.

20. The Medical Officer of Health shall daily send by post to the Local Government Board a return of the number of cases of cholera which during the previous day may have come under the cognizance of the Local Authority, and of the number of recoveries and the number of deaths, with such other particulars as the Board shall from time to time require. The returns shall be in the following form, or to the like effect:—

DAILY RETURN of cases of CHOLERA and CHOLERAIC DIARRHŒA in the District of the [*name of Local Authority*] for the day of .

—	Cases.	Deaths.	Recoveries.
1. Number of cases included in previous returns which on the were remaining under treatment, and of the deaths and recoveries which have occurred amongst such cases on the -			
2. Number of *new cases* which have come under treatment on the , and of the deaths and recoveries which have occurred among such cases - - - - -			
3. Number of cases *still under treatment* on the morning of the -			

Date , 189 .

(Signed)

Medical Officer of Health of the District.

21. The Local Authority shall from time to time as they shall find expedient or as may be directed by the Local Government Board, issue, publish, and distribute in placards, handbills, or otherwise, such admonitory notices as to sanitary conditions within the district, and such advice, directions, and instructions with regard to persons attacked with cholera, and such information as to the arrangements made for affording medical or other assistance in the district, as shall appear requisite.

Given under the Seal of Office of the Local Government Board, this first day of September in the year One thousand eight hundred and ninety-three.

(L.S.) HENRY H. FOWLER,
President.

HUGH OWEN,
Secretary.

II.

To the Urban Sanitary Authorities of Grimsby and Cleethorpe-with-Thrunscoe, and the Port Sanitary Authority of Grimsby;—
And to all others whom it may concern.

Whereas the Urban Sanitary Districts of Grimsby and Cleethorpe-with-Thrunscoe and the Port Sanitary District of Grimsby are now threatened with cholera, and by an Order dated the 1st day of September 1893, We, the Local Government Board, issued regulations with respect thereto;

And whereas it is desirable that further regulations should be made as herein-after contained:

Now therefore, in exercise of the powers given Us by the Public Health Acts, and any other Acts enabling Us in this behalf, We do, by this our Order, make the following Regulations, and declare the

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Epidemic Regulations: Cholera: in Grimsby and Cleethorpe-with-Thrunscoe; 1893.

same to be in force in the said Urban Sanitary Districts and Port Sanitary District, and to apply to any vessels within the jurisdiction of the said Port Sanitary Authority :—

I.—This Order shall be read as one with the said Order of the First day of September, one thousand eight hundred and ninety-three, and the terms used herein shall have the same meaning as in the said Order.

II.—In any of the said districts where the Infectious Disease (Notification) Act, 1889, is not in force, the persons mentioned in section 3 of that Act and the Local Authority shall, under this Order, have the same powers and duties, in relation to the notification of cases of cholera as they would have under that Act if the same had been put in force as aforesaid, and choleraic diarrhœa had been an infectious disease to which that Act applied. In any of the said districts where the Infectious Disease (Notification) Act, 1889, is in force, the persons mentioned in section 3 of that Act and the Local Authority shall, under this Order, have the same duties in relation to the notification of cases of choleraic diarrhœa as they would have under that Act if choleraic diarrhœa had been an infectious disease to which that Act applied. The Sanitary Authority shall forthwith direct circular letters to be sent to all legally qualified medical practitioners in the district informing them of their duties under this Regulation.

Given under the Seal of Office of the Local Government Board, this Sixth day of September, in the year One thousand eight hundred and ninety-three.

HENRY H. FOWLER,
President.

(L.S.)

HUGH OWEN,
Secretary.

NOTICE.—Sections 136, 137, and 140 of the Public Health Act, 1875 (38 & 39 Vict. c. 55), provide as follows :—

The Local Authority of any district within which, or part of which, regulations so issued by the Local Government Board [*i.e.*, regulations such as those contained in the above Order] are declared to be in force, shall superintend and see to the execution thereof, and shall appoint and pay such Medical or other Officers or persons, and do and provide all such acts, matters, and things as may be necessary for mitigating any such disease [in this case cholera], or for superintending or aiding in the execution of such regulations or for executing the same as the case may require.

Moreover the Local Authority may from time to time direct any prosecution or legal proceedings for or in respect of the wilful violation or neglect of any such regulation.

The Local Authority and their Officers shall have power of entry on any premises or vessel for the purpose of executing or superintending the execution of any regulations so issued by the Local Government Board as aforesaid.

Any person who (1) wilfully violates any regulation so issued by the Local Government Board as aforesaid; or (2) wilfully obstructs any person acting under the authority or in the execution of any such regulation, shall be liable to a penalty not exceeding five pounds.

APPENDIX B.

Cholera in England in 1893: Observations by Dr. Klein on reputed Cholera Material submitted to him for Examination and Report.

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Observations on reputed Cholera Material submitted for examination; by Dr. Klein, F.R.S.

Before discussing in detail the results of my examination of materials submitted to me from reputed cholera cases, I would refer briefly to the methods that I have adopted in my investigations. Such reference is, perhaps, the more desirable since the methods in question had regard always to need for prompt report by me as to whether the sample submitted did or did not indicate true cholera.

I. Methods of Investigation.

The proposition that the vibrio, known as Koch's comma bacillus, occurs in the intestine of acute cholera Asiatica, and does not occur in any other known acute intestinal disease of the human subject, is practically universally accepted; on this point all, or at any rate nearly all, pathologists are agreed. By "Koch's comma-bacillus" is meant a vibrio which differs from other species of vibrio occurring in the human intestine in the following respects:—*Morphologically*, *i.e.*, as regards size, shape, and motility: *Culturally*, growth in gelatine plates, in agar, in broth, on potato, in milk, and in peptone solution: and as regards its *Chemical Products*, nitrites and indol formation in broth peptone, or in peptone salt mixture.

This being the case, my examination of the materials submitted to me was mainly directed to ascertaining whether this species of vibrio was or was not present in the intestines or in the dejecta of the different cases. But, of course, when a specimen of bowel was in question, the condition of the intestine (ileum) was always noticed as a necessary preliminary step; since in acute Asiatic cholera the mucous and serous coats of the ileum are always found in a state of congestion, and the epithelium of the inner surface is either detached here and there over large or smaller areas, or is only loosely adherent to the mucous membrane. The congestion of the bowel is in some cases especially conspicuous about Peyers patches, which stand out markedly as deeply red projections; in other cases intense congestion is uniformly distributed over the mucous membrane, and in the latter cases the contents of the ileum are apt to be more or less blood stained. The procedure adopted by me in examination of cholera material was the following:—

(*a.*) *Microscopic Examination of the Contents of the Ileum, and of Dejecta.*

As is now perfectly well known,* Koch's vibrio is to be found in the so-called mucus-flakes in the ileum and in the rice water stools of typical (clinically) cases of Asiatic cholera. The vibrio, along with other bacteria, is present, sometimes in fair sometimes in small numbers; but in certain cases it occurs in such enormous quantity that not only the flakes but the fluid also in which they are suspended are literally crowded therewith, to the almost entire exclusion of other bacteria. Whether abundant or not, these vibrios can, in most cases, be easily recognised within the flakes in groups and in linear masses.

* Koch first announced the fact in July 1884, at the first Conference on Cholera-questions, Berlin.

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In fresh preparations the vibrios are at once conspicuous under the microscope by their curious screw-like movement, particularly when two vibrios are joined endwise forming an S-shaped body, and better still when they are forming a somewhat longer spirillum. By this peculiar screwlike movement they can, in the fresh state, be recognised in stools or intestinal contents that are by no means typical of cholera, as for instance in a more or less thin brownish fœculent fluid. In a microscopic specimen of the fresh material (particularly in the hanging drop) the vibrios, if present in a reasonable number (say several in each field of the microscope), can be easily picked out by this peculiar screwlike movement, even if there are present numerous other motile bacilli, such as proteus vulgaris or bacillus coli. But preparations made after the usual manner of coverglass films, dried and stained, have more often to be relied on. If an epithelial flake from the contents of a typical cholera ileum, or a similar flake from a typical rice water stool, be crushed and spread out in a thin film between two coverglasses, then dried, stained, washed, and mounted, it is found that such flake presents a very characteristic appearance. It contains the comma-bacilli—single commas or S-shaped forms—in groups and in linear masses. Koch graphically compares this arrangement to the manner in which a party of fish distribute themselves in a stream. This is well shown in Figures 3 and 4, Plate I., and in Fig. 13, Plate IV. When the appearances in the flakes (of the intestine or of the rice water stool) are of this character there can be no question as to the nature of the case; such appearances occur only in Asiatic cholera. On this point I think there is no divergence of opinion at present, and Koch's statement that a case that affords material presenting such appearances is true Asiatic cholera is, I consider, fully justified.

Unfortunately, however, even in true cholera, this appearance is not always found; in fact, only in a minority of cases does such condition obtain. Of above fifty cases that I examined during the occurrence, in 1893, of cholera in England, in fifteen only could the diagnosis of cholera justifiably be made at once solely from examination of coverglass specimens prepared in the above manner. More frequently, though the contents of the ileum were fairly typical (epithelial flakes in fairly clear fluid), the flakes and the fluid contained relatively few comma-bacilli recognisable with sufficient definiteness in stained coverglass specimens. On the other hand, numerous other bacteria, bacillus coli predominantly, were present in the flakes as smaller or larger clumps and masses, among which only here and there could a few comma-bacilli, in rows or in small aggregations, be recognised; whilst in the fluid containing the flakes only a few isolated comma-shaped bacilli amongst numerous other bacteria were detected. It is clear that from such microscopical appearances nothing in the shape of definite diagnosis could be ventured upon. The bare fact of the occurrence of comma-shaped bacteria similar in size, shape, and motility to Koch's vibrios, was all that could be stated. What were the biological characters of those comma-shaped organisms could obviously only be determined by growing them in suitable culture media. In yet another class of case—and in this class were the majority—the contents of the ileum or the dejecta submitted to me, though more or less fluid, were not of rice water character; they were perhaps brownish in colour, sometimes distinctly bloodstained. Such samples when examined under the microscope revealed in some instances epithelial flakes, in others no flakes at all; but all the coverglass specimens showed crowds of different kinds of bacteria, amongst which here and there a comma-shaped organism could often be recognised. In cases of this sort obviously further

observation of the material by culture in suitable media was of essential importance. But before proceeding to discuss cultural tests for the organisms present in the samples submitted to me, there will be advantage in referring in detail to some important and interesting facts that were ascertained as a result of my study of comma-shaped organisms in coverglass specimens.

In the cases in which the rice water stool, or the rice water like contents of the intestine, contained the commas in abundance, sometimes almost in pure culture,* coverglass specimens made of the fluid and of the flakes, dried and stained for ½—1 minute in anilinwater gentian violet solution † and absolute alcohol in about equal volumes, and afterwards well washed, dried, and mounted, revealed the interesting fact that not only the comma-bacilli themselves but their flagella also become distinctly visible as a result of the process. Figs. 1 to 10 (Plate I., II., and III.), show this very clearly. A large number of free flagella, some of great length (8 to 12 times as long as the comma-bacilli themselves) some shorter, are seen scattered about; either singly or in small groups, or in masses consisting of large numbers densely matted together. These free flagella are slightly wavy or spiral or twisted. Examining the specimens more in detail, here and there a comma-bacillus is seen to which one or two or even three longer or shorter flagella are still attached. Considering that in some parts of the flakes there are large masses of free flagella present and only a relatively limited number of commas or S-shaped forms, the suggestion arises that some commas possess more than one flagellum; and as a matter of fact it is not difficult to find grouped together two or three free flagella which seem to start from a common point and spread out in different directions. Now it is known from the observations of Löffler‡ that comma-bacilli from artificial cultures are found to possess a single flagellum only, and that this flagellum is not visible unless the sample of culture material be treated with a mordant previous to staining. It therefore follows that some of the comma-bacilli in the stools and intestinal contents differ from comma-bacilli derived from cultures in the fact of possessing more than one flagellum. That this is so, seems indicated from the manner in which the comma-bacilli of the stool or intestinal contents move in the fresh state. If a careful watch is kept on single commas, it is seen that some of them show their screwlike movement not in one direction only; they move in one direction for a space, then rapidly move in the opposite direction. This seems to imply that such bacilli possess at least one flagellum at each end. When S-shaped forms are watched they are sometimes seen after moving screwlike for a space in a given course, to suddenly swerve off at an angle to the direction in which they had been just moving. This would appear to indicate that one end or the other the S-shaped form possesses more than one flagellum. The same action is observed also of single commas. From the fact that the comma-bacilli of cultivation show in stained specimens their flagella only after the application—previous to the staining—of a mordant, whereas those of the stool or of the intestinal contents show their flagella by the simple process of staining, it follows that there must be present in the intestinal fluid some substance which acts like a mordant. I am not, however, in a position to say what such substance may be.

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* Hull (2), Grimsby (2), Rotherham, Westminster, Retford, Derby, Leicester, Yarmouth (2), Accrington, Balby, Rawmarsh, and North Bierley.

† Anilin water 100 parts, saturated alcoholic solution of gentian violet 11 parts.

‡ Centralblatt f. Bakt. and Parasit, &c., vol. VI., p. 219.

The most perfect permanently stained specimens both of the comma-bacilli and of their flagella I have obtained from the rice-water stools. I take a flake of such a stool and stain it first bodily in the above aniline gentian violet solution for a few minutes; then after good washing in distilled water I crush it between two coverglasses so as to leave a thin film of the flake on each of these glasses; and finally I dry and mount in balsam. In such specimens the comma-bacilli and S-shaped forms appear of remarkable sharpness and are deeply stained; their flagella are very distinctly stained also, though they appear of a lighter colour. Figs. 1 and 2, Plate I., and Fig. 8, Plate II., show these points very well.

Now the easy way in which the flagella become stained in the above gentian violet dye, if a film only of the stool or of the ileum contents be used, has in several instances enabled me to foretell with certainty the presence in a particular sample of material of Koch's comma-bacilli. Thus, in certain stools or ileum contents, in which, on microscopic examination as dried and stained films, few distinct comma-shaped bacilli only could be recognised amongst crowds of straight bacilli, the presence of numerous stained free flagella of the same aspect as those found in preparations of typical rice-water stools, enabled me to say that there were most probably present in such specimens Koch's comma-bacilli. And on subsequent culture of the material in peptone solution my surmise was fully justified. I mention here, in illustration, two out of several instances:—As regards material from Fulham, the ileum contained a brownish slightly bloodstained fluid. In coverglass films, after staining and mounting, great numbers were noted of various sized, short and long, straight bacilli, with here and there one that not only looked curved like a comma-bacillus but in size was identical with the cholera vibrio. But in addition—and this was the remarkable feature of the specimen—there were present in great number free flagella. Fig. 5, Plate II., illustrates this. In it are seen a number of free flagella, though none of the bacterial forms in the particular field of the microscope can be identified as comma shaped. Here and there only, at other places in the specimen, a typical comma-bacillus occurred (some with a flagellum attached), but everywhere large numbers of the free flagella were met with. From this I felt almost certain that cultures would yield positive results as to the presence of the Koch's comma-bacilli, and this surmise was, by peptone cultures, proved to be correct. A Liverpool case was still more instructive. I received a piece of the ileum (ligatured at both ends) that had been kept in a sealed jar for nearly 10 days after death. On opening the intestine, which was much injected, no fluid was found in the cavity, but the epithelium was either loosened or in many parts quite detached. On making microscopic specimens, and staining them, there were seen amongst a large number of bacilli (bacillus coli and proteus) a considerable number of free flagella; only here and there could a bacterium be found which resembled a curved (comma-shaped) bacillus. Fig. 14, Plate IV., shows a considerable number of such free flagella, but in this field of the microscope no definite comma-bacillus was detected. In this case also the peptone culture yielded positive evidence of the presence of Koch's comma-bacilli. As will appear from my subsequent detailed description of the several samples submitted to me, other cases yielded the same proof of the correctness of my preliminary surmise, though, as will also appear from the detailed description, there were some cases in which such surmise was not verified by subsequent culture. At any rate this much may be said: If from typical stools or intestinal contents, specimens prepared and stained in the above manner show free flagella such as are depicted

in Figs. 1 and 8, Plates I. and II. respectively, peptone culture will in the majority of instances—notwithstanding that the number of curved bacilli (commas) amongst crowds of other straight bacteria appears altogether insignificant—prove the existence of Koch's comma-bacilli.

(*b.*) *Cultural Testing of Bowel Contents and of Dejecta.*

In those cases*, which presented under the microscope the typical appearances of Asiatic cholera—*i.e.*, crowds of Koch's commas in the mucus (epithelial) flakes, in some instances almost in pure culture—there was no difficulty in obtaining pure cultures of these commas by the following methods.

(*a.*) A particle of a flake from such a sample, placed in peptone broth and incubated at 37° C., yielded in 24 hours, in the superficial layers of the broth, an abundant crop. This, in the form of a thin pellicle, was, in most instances, practically a pure culture of the cholera vibrio; in any case, pure subcultures were easily made from this superficial layer.

(*b.*) By placing a particle of a flake from such sample in boiled salt solution or in broth, shaking it up, and then making by means of a platinum needle inoculation of gelatine or agar, with a view to plate cultivations. In such agar plates, after 20–30 hours' incubation at 37° C., numerous colonies of Koch's commas were to be found, from which subcultures were easily established. In the gelatine plates, after 2–3 days incubation at 20–22° C., numerous typical colonies of Koch's commas were obtained. They were noticed as small pits after 30–48 hours; during the third, and better during the fourth day, they were well marked by the liquefied condition of the gelatine about the colonies, and from these colonies subcultures were easily made.

(*c.*) By placing a particle of a flake from such sample direct into the Dunham peptone salt solution (1 p.c peptone, 0.5. p.c. sodium chloride), or by first distributing (or diluting) the flake in salt solution, and then, by means of the platinum needle, inoculating from this dilution other tubes containing the Dunham solution. The peptone solution, in whichever way inoculated, shows after 6–8–10 hours incubation at 37° C., a definite turbidity due to the rapid growth and multiplication of Koch's commas; and contains indol and nitrous acid, as is demonstrable by the addition of one or two drops of pure sulphuric acid, which produces the characteristic pale rose pink or "cholera red" reaction. (*See* Figs. 1(*a*), 2(*a*), and 3(*a*), Plate XIII.). This fact is justly insisted on, in confirmation of Dunham and Dunbar, by Koch, in his latest publication.† He points out that amongst the microbes which might become introduced into the peptone culture from the intestinal contents or stools (*e.g.*, bacillus coli, proteus vulgaris, vibrio of Finkler, &c.) there is no organism, except his cholera vibrio, which shows in this peptone solution, in so short a space as 6–12 hours at 37° C., rapid growth, and which at the same time affords the cholera red reaction. It is therefore obvious that this medium is for speedy diagnosis of the utmost importance.

In most of the above cases, where the flakes contained the comma bacilli almost to the exclusion of other bacteria, the peptone method enabled me to say within 16 hours that I was dealing with Koch's comma-bacillus. So, too, as will be shown presently, in many other cases where at the outset the comma bacilli were in a small minority as compared with other bacteria, the Dunham peptone salt medium

* As, for instance, cases from Hull, Grimsby, Westminster, Rotherham, Retford, Derby, Leicester, Yarmouth, Accrington, Balby, Rawmarsh, and North Bierley.

† Archiv. f. Hyg. and Infect., vol. XIV., p. 332.

was of immense service. It enabled me to obtain sometimes in 6–12 hours, at latest in some 16 hours, a crop of commas in the superficial layer of the peptone solution, from which further subcultures in fresh peptone salt solution (and other media) could at once be established; so that before 24 hours had elapsed since the commencement of the examination, pure subcultures and the cholera red reaction were obtained in secondary peptone tubes.

The broth-peptone cultures, on the other hand, succeed only where the comma-bacilli are from the first fairly abundant in the flakes; that is to say, one can secure in this way within 24–30 hours, a surface layer of pure culture of commas, and obtain also on the addition of sulphuric acid, the cholera red reaction. But in those cases where the comma-bacilli are comparatively much mixed in the stools or intestinal contents with other bacteria, this method fails to give positive result.

Gelatine plates, agar plates, agar surface cultures, gelatine stab and potato cultures, can as stated above be successfully established from the stools or intestinal contents if at the outset the comma-bacilli are predominating over other bacteria, or if at any rate they are fairly numerous as compared with others. In such case by diluting the materials (stool or intestinal contents), and then inoculating the above materials with a trace of the dilution, successful results are obtained. There is of course no difficulty in obtaining pure subcultures in all these media from a previous successful peptone culture; and a successful peptone culture, as has been stated above, is easily made even when the original materials contain only few commas.

In the latter cases, *i.e.*, where few commas were found in the materials, or even in cases where the microscopic examination failed to give definite evidence of their presence, inoculation of peptone-salt tubes yielded positive results in 6–12, at latest in 16 hours, whereas in like circumstances the cultures in all other media commonly failed. It is therefore with special reference to this class of cases that the peptone salt cultures proved of the highest value and importance.

It is not necessary to give here a detailed statement of the appearances of the colonies and of the growth of Koch's comma bacillus, since they have been so often described, and are so well known. It will suffice to restate their salient features from the point of view of my own observations:—

(1.) *In Dunham's peptone* (1 per cent. or 2 per cent.) *salt* (0·5 or 1 per cent.) *solution*, the cholera vibrio grows rapidly at 37° C., so that in no more than 6–12 hours the solution is uniformly slightly turbid. In 24 hours there is commonly an indication of imperfect thin film on the surface. The cholera red reaction (nitrite and indol) is found distinct as soon as turbidity is noticeable, provided that the culture is fairly pure as regards comma bacilli. There is, indeed, as Koch points out, no known organism except his vibrio which, in this medium, gives in so short a period the red reaction that is in question. But it needs to be insisted that pure sulphuric acid must be used. If the acid contains nitrites, a red reaction may result from the life processes in the peptone medium of organisms other than Koch's vibrio. It is true that in such case the colour does not persist, as does the true cholera-red; nevertheless it has ere now led to erroneous diagnoses. The precise tint of true "cholera-red" is a rose madder, faint in young cultures, more defined in older cultures. In Figs. 1(*a*), 2(*a*), and 3(*a*), Plate XIII., these different appearances are accurately represented after 24, 48, and 96 hours incubation at 37° C. It will be noticed that the depth of the tint varies in these periods; a deeper tint than the last is

not obtainable. As a matter of fact, the maximum depth of tint is obtained in four days' growth.

(2.) *In broth peptone*, the appearances are similar to those in peptone salt solutions, except that in the former no such rapid growth and no distinct cholera red reaction is obtained at such early periods as in the latter. After some (4–8–12) days' growth at 37° C., a thickish white pellicle is present on the surface of the broth; but in this latter respect the comma bacilli differ in the different cases, for while in some the pellicle is thick and coherent, in others it is only indicated as a thin scaly film, and in others again it is absent.

(3.) *In gelatine plate cultivations* incubated at 20–22° C. the colonies become marked, in 2–3 days, as minute grey dots situated in pits due to commencing liquefaction of the gelatine. Later, and as liquefaction proceeds, each colony presents a circular area of fairly clear liquefied gelatine, and in the central depression a whitish dot. This when viewed under a magnifying glass is seen to be made up of minute granules, densest in the centre and extending thence in less dense aggregation towards the periphery, but only about half-way thereto; so that the depressed liquefied area seems to be dotted with greyish granules like minute glass splinters. There exist considerable, and stable, differences in the amount and extent of this granulation, as also in the rapidity of the growth of, and the liquefaction by, the colony.

(4.) *In Agar Plates* incubated at 37° C., the colonies appear after 24 hours as greyish flat round dots; later they become thicker and larger, and when seen in transmitted light are light-brownish and granular. There exist also stable differences in these respects between the comma bacilli of different cases. In some the colonies remain small, greyish in reflected light, translucent and light brown in transmitted light; in others they soon become larger and whitish in reflected light, opaque and dark brown in transmitted light.

(5.) *In gelatine stab culture*, the growth first shows itself as whitish granules appearing after 24–28 hours along the line of the stab; then the surface becomes drawn in and funnel-shaped and occluded by an air-bubble, from which liquefaction gradually spreads towards the deeper parts. The liquefied gelatine is sometimes fairly but not quite clear, in others it is uniformly turbid; at the deeper parts of the liquefied portion there is a whitish granular deposit. When liquefaction has proceeded for some days a pellicle, at first thin and greyish afterwards thick and whitish, appears on the surface in some cases, but is absent in others. In 1891, on the occasion of the International Congress of Hygiene, I brought forward in the Bacteriological Section cultivations derived from Dr. D. D. Cunningham and obtained by him from cases of Asiatic cholera in Calcutta. Of these cultivations I maintained, as had Dr. Cunningham, that they show that the comma bacilli derived from different cases of Asiatic cholera belong to well-marked varieties; that is to say, as regards aspect and progress of the growth in gelatine plates and in gelatine stab cultures, the differences are of a stable character and do not merely occur now and again and indiscriminately. In the discussion which followed, Prof. Hueppe and Prof. Gruber maintained the contrary and denied that from these differences any conclusion as to different varieties can be drawn. Dr. Friedrich, of Berlin, to whom I sent subcultures of the different varieties, also opposed this conclusion. Now it has since been established by a variety of independent observers, including both Hueppe and Gruber that Cunningham's contention is perfectly correct. In a Paper published

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elsewhere on the Pathology and Etiology of Infectious Diseases,* I have given a series of photographs and drawings illustrating Cunningham's different varieties of cholera comma-bacilli; and I can now, from the observations made on the cases of cholera occurring in 1893 in England, supplement my former contention by stating that culturally the comma-bacilli isolated from cases of cholera in England showed stable and marked differences. These, as far as they are apparent in gelatine stab cultures, are represented in the several drawings in Plates VII. to XII. inclusive. The differences presented in potato cultures will be presently described.

In further illustration of the stability, in the laboratory, of certain of these differences, I would especially note a case† amongst those examined by me in which comma-bacilli isolated by the peptone salt method behaved in morphological respects, in peptone culture, in cultures on agar and in broth, and as regards cholera red reaction, like Koch's cholera comma-bacillus; but nevertheless differed therefrom in the remarkable point that they did not liquefy gelatine in stab culture. Stab cultures in this medium made in September showed in November a line of granules in the track of the needle, but no trace of liquefaction. Broth cultures, agar cultures, and peptone cultures however made from such a stab culture behaved in all respects like Koch's cholera comma-bacilli, with inclusion of the cholera red reaction. Morphologically they were typical commas, S-shaped and spiral forms. Now the still more remarkable fact is that in gelatine plate cultivations made from such non-liquefying stab cultures the colonies showed a tendency to tardy liquefaction, but when from such a liquefied colony subcultures, whether on the surface or in the depth of gelatine, were made, there, was again complete inability of the organisms to liquefy the gelatine, though in other media they behaved like Koch's comma-bacillus. These subcultures were thoroughly tested for their purity, and the result was absolutely unequivocal. In some stab cultures showing for several weeks good and copious growth without trace of liquefaction, a disturbance by the sterile platinum loop of the superficial parts of the growth having been made, liquefaction, strange to say, at once commenced from the top and gradually proceeded towards the depth in the normal fashion. When liquefaction had thus well set in, new gelatine plate cultivations were made. In these subculture plates the colonies that made their appearance were all of the same kind, and liquefied the gelatine tardily as at first, with the ultimate result of producing typical colonies of Koch's commas. When, however, from such a colony new stab cultures were made in gelatine, though good growth occurred, again no liquefaction resulted. It ought to be stated that the nutritive gelatine was in all cases—both in this particular case and in the others—of exactly the same nature, and the methods used for making the cultures were exactly alike; yet there occurred this remarkable difference between the gelatine cultures of the particular case and of all the others. Though I cannot give an explanation of these differences, I am justified in saying that the comma-bacillus of the case in question is a distinct variety approaching those of some other cases in which liquefaction of the gelatine is conspicuously slower than normal.‡

It is noteworthy that Dr. Cunningham in his observations of the varieties of the comma-bacilli in Calcutta cholera cases, mentions one variety which failed to liquefy gelatine.

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* Part II. of Stevenson and Murphy's Treatise on Hygiene.

† From Southwark.

‡ Cases from Rawmarsh, Keighley, Grimsby, Yarmouth, and Hull (see Plates VII. to XII.).

(6.) *On potato.*—In the paper already referred to * I have given illustrations of the different varieties of cholera comma-bacilli, isolated by Dr. Cunningham, and I have now to add that the comma-bacilli from the cases in England, showed the same kind of appearances in their growth on potato. Inoculation of the surface of bits of potato (the potatoes were all exactly of the same kind, they were incubated at 37° C.) contained in test tubes were made from the various English comma-bacilli, and the result was that they produced in five to six days good, but colourless, growth, except in one case,† in which the growth was brownish, and in other three‡ in which the growth was faint yellow.

(7.) *In Milk.*—The typical Koch's comma-bacillus, when cultivated at 37° C. in normal alkaline milk previously sterilised, grows copiously, but does not produce any visible alteration in the physical characters of the milk; this retains, Koch says, indefinitely its fluid character. When, after two or three days incubation, new subcultures from such milk are established in the various media, pure crops of the comma bacilli are obtained. In all experiments with the comma bacilli obtained from the English cases, skim milk, sterilised and contained in test tubes, was used as a culture medium, and these tubes were then incubated at 37° C. The results were that, in the majority of instances, comma-bacilli which corresponded in all other respects to Koch's vibrio, were found to possess the power of sooner or later coagulating milk§

(8.) *Physiological effects on guinea-pigs.*—In my Report for 1892–1893‖ I have shown that though Koch's comma bacilli injected in large doses into the peritoneal cavity, as practised by Pfeiffer and Haffkine, produce acute intense peritonitis and death, this action is in no way specific or peculiar to Koch's comma-bacillus. Clinical symptoms and pathological appearances, in all respects similar, are indeed caused by a variety of other microbes, pathogenic and non-pathogenic, *e.g.*, the vibrio of Finkler, the bacillus prodigiosus, the proteus, the staphylococcus aureus, bacillus coli, and the bacillus of typhoid fever; though for production of fatal result, I had in all instances to inject large doses of agar culture distributed in bouillon into the peritoneal cavity, namely, $\frac{1}{8}$–$\frac{1}{2}$ the scrapings from a culture tube.

Now Koch in the publication, already quoted by me, states that one of the means of identifying his comma bacillus in a given case of disease, is injection of a culture of the organism isolated into the peritoneal cavity of guinea-pigs; and that his bacillus thus injected produces the death of the animal. But seeing that I have shown that other comma bacilli (vibrio of Finkler) and various other non-comma shaped bacilli produce exactly the same result, it must be clear that this method of identifying Koch's comma bacilli is of no real value. Moreover, Sanarelli in a recent important paper¶ shows that a number of species of comma bacilli isolated by him from various waters in and about Paris have more or less the same pathogenic action on guinea-pigs.

Koch also states that his comma bacillus, on intraperitoneal injection into guinea-pigs, produces the fatal result in very small doses,—a single platinum loop of an agar culture. This statement is, however, to me altogether surprising, since in no single instance

* Stevenson and Murphy's Treatise on Hygiene.
† From Leicester.
‡ From Ilkeston, Coton Hill, and Accrington.
§ As for instance, Grimsby 2, Leicester, Retford, Kennington, Croydon, Tividale, Liverpool, Balby, Rawmarsh, Bingley, and Keighley.
‖ Report of the Medical Officer for 1892–93: Appendix B. pages 369–371.
¶ Annales de l'Institut Pasteur, November 1893.

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out of the many cases in which the cholera comma-bacilli have been found by me in England was anything approaching this virulence noticed. The agar tubes were in each instance made from cultures of the same pedigree (the third or fourth remove); the agar surface of growth was 6 centimetres by 2; and in all cases after 48 hours growth at 37° C. the whole growth was scraped off the agar and distributed in sterile broth. In order to produce a fatal effect in the guinea-pig, it was necessary for me to use in some instances as much as one-fourth of a tube of an agar culture, in others as little as one-sixth or even one-ninth of a tube; but though one-ninth of a tube did on occasion suffice to produce a fatal result, the animals as a rule recovered.

Furthermore, I ascertained that the *same* agar cultures were not equally virulent with different guinea-pigs. Thus one sixth of an agar culture derived from a non-fatal Yarmouth case (No. 2) proved fatal in one animal, whereas one third of the same culture produced no result in another animal of the same weight which was injected at the same time. So, too, a culture from a fatal Fulham case proved non-fatal in the amount of one sixth of the tube at one occasion in one guinea-pig, while in another guinea-pig one eighth of the tube sufficed for fatal result. So that no definite law was to be found either as regards the relation of the virulence of the culture to the acuteness of the case from which it was derived, or as regards the uniformity of action—so far as quantity is concerned—of one and the same culture.

As to the character of the clinical and pathological symptoms produced in the guinea-pigs by these intraperitoneal injections, the distribution of the comma-bacilli in the peritoneal exudation and in the blood of the general circulation, with the identity in all these respects between the action of the cultures of cholera commas and of several other bacterial species, I have nothing to add to what I described and figured in my report for 1892–93.

II.—The Materials examined, and the Sources whence they were derived.

Having thus described all the essential points relating to the methods of examination adopted and the general results obtained, I now proceed to describe in detail the results of my examination of the several materials submitted. These will be taken in the chronological order in which the materials were received by me.

No. I.—Hull case No. 1.*—Received on August 28th from Dr. Mason the intestines of a boy J. H. F., who was taken ill at 6 a.m. on Thursday 24th August, and who died at 2.30 p.m. the same day. The intestine was much congested, and contained much rice water-like fluid full of greyish white flakes. These flakes examined under the miscroscope were made up of masses of epithelium detached from the mucous membrane. In stained preparations of these flakes, the appearances as regards number and distribution of the contained comma-bacilli were typical of cholera. Cultivations made in peptone salt solution, in gelatine plates, in broth peptone, and in agar plates, gave positive results. After 16 hours incubation the peptone salt solution showed pure culture of cholera commas, and gave the typical cholera red reaction. The gelatine and agar plates yielded also numerous colonies of cholera commas.

* Examined for the Hull Sanitary Authority.

No. II.—Grimsby case No. 1.* On August 30th, I received from Grimsby a bottle containing typical rice water stool, and, in another bottle, a piece of ileum of a woman who had died under suspicion of cholera. The rice water stool, as also the intestine, was characteristic of cholera. In both there was abundance of epithelial flakes which were found crowded with comma-bacilli. Cultivations of these proved typical in all media. Peptone salt solution, broth peptone, and gelatine plates, inoculated each with a particle of a flake previously shaken up in sterile salt solution, yielded pure cultivations of Koch's commas. Cholera red in the first peptone tubes taken, was very distinct after 16 hours incubation at 37° C.

No. III.—Grimsby case No. 2.* Received, 1st September, from Dr. Newby the ileum of a person supposed to have died from Cholera Asiatica. The contents of the gut were fluid and slightly tinged with blood; the mucous membrane was much congested, and the epithelium loose on the surface over large areas. In the contents were numerous epithelial flakes, crowded with commas. Cultivations in peptone salt solution yielded, after 12–16 hours incubation at 37° C., pure crops of cholera commas, and gave the characteristic cholera red reaction. Plate cultivations were made from the peptone tubes in gelatine and in agar; also stab cultivations in gelatine and inoculation of broth. In all these cultures pure growth of Koch's comma bacilli was obtained.

No. IV.—Hull case No. 2. The ileum of a woman (M.), who died under suspicion of Asiatic cholera, was received by me 1st September. The intestine and its contents proved typical of cholera. Epithelial flakes therefrom contained very abundantly comma bacilli, and cultivations in peptone salt solution and in gelatine plates showed them to be Koch's commas. Subcultures in all media were similarly typical.

No. V.—Rotherham case. Received on September 7th a piece of ileum of a man who died of supposed Asiatic cholera in a few hours. The intestine was congested and of a uniform rose colour. In the interior there was a solid mass of gelatinous material, in which under the microscope masses composed solely of epithelium could be distinguished. This condition of the intestine,—*i.e.*, presence of solid gelatinous masses—reminded me of a cholera case rapidly fatal that I had the opportunity of seeing while in India, in which there had been no purging; it was one of those rare instances of so-called "cholera sicca." In the gelatinous masses of the Rotherham case there were crowds of Koch's comma-bacilli; and, as gelatine plate cultures, cultivation in peptone solution, and cultivation on the surface of agar proved, they were present without the admixture of other organisms.

No. VI.—Westminster case. Mrs. B., cleaner in the House of Commons. Dr. Sweeting handed over to me on September 7th a bottle containing rice water-like dejecta, and a piece of ileum. The ileum was greatly congested, in its interior was rice water-like fluid. Numerous flakes in the stool and within the ileum were made up of epithelial cells, and contained Koch's comma-bacilli and S-shaped forms in crowds; grouped, too, in the characteristic arrangement. Figs. 3 and 4, Plate I., show this well. Similarly in the fluid of both stool and bowel contents numerous commas could be seen, and their flagella were brought out conspicuously by the staining process. The preliminary examination revealed then a condition such as is found in Asiatic cholera, and in Asiatic cholera only: Namely, the rice water-like stool, the congested ileum, its rice water-like

* Examined for the Grimsby Sanitary Authority.

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contents, the epithelial character of the flakes, and the crowds of the comma bacilli in them, in shape, size, and motility exactly like those seen in Asiatic cholera. The first series of cultivations of the flakes from this case in peptone salt solution, in agar, in broth, and in gelatine proved in all respects pure cultivations of Koch's comma-bacilli; and the peptone cultures gave very pronounced cholera red reaction. In this particular case the symptoms had been, as a matter of fact, strongly suggestive of Asiatic cholera. But had the clinical history of the case seemed to contraindicate cholera, or had the post-mortem examination seemed to signify death from some other cause, I should, from the preliminary microscopic and cultural examination—in fact from the former alone—have said, without the slightest hesitation that this woman was affected with, and had died from, Asiatic cholera. The whole pathology and the microscopic and cultural features of this case were in fact absolutely typical of a pure case of Asiatic cholera. It is unfortunate that the antecedent history of this woman remains uncertain, that is to say, it has not been established by what means and in what way she contracted cholera. But this in no way cancels the evidence indicative of true cholera. All that we know as positively indicative of cholera was found here; no one has yet found in any known acute disease of the intestine, except in Asiatic cholera, this association of facts; namely, rice water stools; a congested intestine; rice water-like contents of the intestine; and epithelial flakes in the stools and intestinal contents crowded, almost in pure culture, with comma-shaped and S-shaped organisms, which in morphological and cultural respects completely resemble Koch's comma-bacillus.

No. VII. St. Bartholomew's Hospital case No. 1.*—Henry J., *æt.* 24. Patient was taken ill at Clerkenwell on the morning of September 8th, with sickness and severe diarrhœa; stools rice water-like, cramps very pronounced. The fluid rice water stools contained flakes; but these were not epithelial, only leucocytes and mucus. In the material a few free flagella, and some suspiciously comma-shaped-looking rods were observed, besides crowds of bacillus coli. Cultivations, however, proved negative as to comma-bacilli. The patient after being taken into the wards of St. Bartholomew's Hospital soon recovered.

No. VIII. Doncaster case. — Received from Doncaster on September 9th a piece of ileum ligatured at both ends. Unfortunately the intestine had been placed the day before in a bottle of spirit. On opening the intestine there was in it a brownish slightly blood-tinged fluid. On microscopic examination numerous epithelial flakes and a fair number of comma-shaped and S-shaped forms, besides other bacteria, could be recognised. Cultivations were made, but they all proved sterile; the bacteria in the intestinal fluid had been killed by the spirit in which the bowel had been preserved.

No. IX. Boston case.—Ileum and colon (of a woman 47 years old) received on September 9th. The bowel contents comprised numerous epithelial flakes, in which were many comma-shaped bacilli and also other bacteria. Cultivations were made which proved positive. Peptone cultures yielded after 16 hours at 37° C. abundant crops of comma bacilli, and afforded also the cholera red reaction. Subcultures made in the different media, all showed the commas to be identical with Koch's comma-bacillus.

* Examined for the London County Council.

No. X. Morton (Gainsborough, R.) case.—Received on September 11th a piece of ileum and colon of J. R. In the intestinal contents were numbers of epithelial flakes, which, as stained cover-glass specimens, showed numerous free flagella, and a few comma-shaped organisms, besides crowds of straight bacilli. Peptone salt cultivations yielded positive results, and subcultures therefrom produced pure cultivations of Koch's comma-bacillus.

No. XI. Willesden case.—Received on September 11th a bottle containing fluid greyish brown dejecta of Mr. E., aged 60 years. Microscopic examination yielded doubtful result; cultivations also proved negative. It ought to be stated here that this stool was voided on the sixth day after commencement of illness.

No. XII. Leicester case.*—Received from Dr. Priestley on September 11th a piece of intestine (ileum) derived from a reputed cholera case. The contents were fluid and sanguineous; the intestine itself was much congested. Microscopic examination of the contents of the ileum showed epithelial flakes with crowds of commas and S-shaped organisms; in the fluid numerous other bacteria. Cultivations of flakes in peptone salt solution proved positive. Subcultures from these showed the bacilli to be Koch's commas.

No. XIII. Handsworth (Yorks)case.—Received on September 12th from Dr. Scott a piece of ileum. The intestine contained mucoid fluid matter full of epithelial flakes with crowds of bacteria, amongst which some that might be comma-bacilli. Cultivations in peptone salt solution yielded positive results. Subcultures therefrom made in the different media demonstrated the presence of Koch's comma-bacill.

No. XIV. Retford case.—Received on September 12th a piece of ileum, distinctly congested, in the cavity of which there was typical rice water-like fluid. On microscopic examination numerous epithelial flakes were seen. Both the fluid contents of the bowel, as also the flakes, contained comma-shaped and S-shaped bacteria in almost pure cultivation. Cultures from the flakes made in peptone salt solution, in gelatine plates, on the surface of agar, and in broth peptone yielded pure cultures of Koch's comma-bacillus.

No. XV. Fulham case.—Received on September 12th, through Dr. Copeman, a piece of ileum and cœcum of a woman, who died with suspicious symptoms in the Fulham Workhouse Infirmary. The intestine was deeply congested; its contents fluid, like pea-soup, showed under the microscope numerous epithelial flakes. These contained crowds of bacteria, amongst them a few comma-shaped forms and numerous free flagella (*see* Fig. 5, Plate II.). Cultivations in peptone salt solution yielded positive result in 16 hours. Subcultures therefrom in the different media yielded pure crops of Koch's comma-bacillus; cholera red reaction in peptone cultures well pronounced.

No. XVI. Clacton-on-Sea case.—Rice water-like stool (from Kate W., 10 years of age) received on September 12th. It contained numerous flakes, not epithelial; they were made up of leucocytes. The fluid and flakes appeared on further examination to be pure cultures of bacillus coli; in the flakes, for instance, there were streaks and connected masses of this organism. Cultivations yielded negative results; no comma-bacilli appeared, only colonies of bacillus coli.

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* Examined for the Leicester Sanitary Authority.

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No. XVII. Kennington (Lambeth) case.*—Received on September 12th, from Dr. Hamer, a piece of ileum of Thomas E. Gut much congested; its contents fluid grumous; numerous epithelial flakes, containing amongst crowds of straight bacilli some distinctly comma and S-shaped forms. Cultivations in peptone salt solution yielded at once (in 16 hours) crops of comma-bacilli, which in subcultures in the various media proved identical with Koch's commas. Distinct cholera red reaction obtained.

No. XVIII. Ashbourne case.—Received on September 13th, from Dr. Littleton, a piece of ileum of a person who had died, it was suspected, of cholera. The intestine was much congested; its interior was filled with gelatinous material, in which numerous greyish white filaments and membranes could be distinguished. In the numerous epithelial flakes were crowds of bacteria, amongst them some few undoubtedly comma-shaped organisms. Cultivations in peptone salt solution positive. Subcultures from these all yielded pure crops of Koch's comma bacillus.

No. XIX. Mitcham (Croydon, R.) case.—Received on September 14th a bottle containing evacuations (of H. B.) washed out of a soiled sheet. Microscopic examination showed amongst crowds of cocci and straight bacilli a few undoubted comma-shaped bacilli. Cultivations made in peptone salt solution proved negative as to commas. (*See also* No. *XXI.*)

No. XX. Mansfield case.—Received on September 15th a stool voided on September 12th by a patient ill with suspected cholera. The stool was fluid, like pea-soup. Microscopic examination showed amongst a crowd of bacillus coli a few suspicious, *i.e.*, comma-shaped bacilli. Peptone salt cultivations proved negative. Two gelatine stab cultures made at Mansfield by Mr. C. Wills each contained a pure growth of bacillus coli.

No. XXI. Mitcham (Croydon, R.) case. (*See also* No. *XIX.*)—Received September 15th a piece of intestine and a stool. The intestine was congested, and contained a brownish fluid; this was also the character of the stool. Microscopic examination showed amongst crowds of straight bacilli a few that were distinctly comma-shaped. Peptone cultivations were made both of the intestinal contents and of the stool, but they proved negative; no cholera commas appeared.

No. XXII. Croydon Borough case.—Received on September 15th a piece of ileum and a fluid stool of a person supposed to have died from "English cholera." The intestine was injected, and contained brownish fluid matter; the stool was fluid and brownish. Microscopic examination showed both in the intestinal contents and in the stool numerous epithelial flakes, and amongst crowds of different bacteria some distinctly comma and S-shaped forms. Also there were numerous free flagella. Cultivations made of the intestinal contents and stool in peptone salt solution yielded good crops of commas. Subcultures proved these to be Koch's comma-bacillus. Cholera red reaction pronounced.

No. XXIII. St. Bartholomew's Hospital, case No. 2* (E. C. E., *æt.* 5).—A fluid rice water-like stool voided on September 15th, by a schoolboy

* Examined for the London County Council.

brought into hospital from St. Luke's, suffering with severe sickness and purging. The stool contained numerous flakes, but these were not of epithelial character. Amongst a crowd of various bacilli there were some few that looked like commas, and also a few free flagella. Cultivations in peptone salt solution did not yield comma-bacilli. The patient recovered.

No. XXIV. Derby case.—Received on September 16th, part of the ileum of woman who had died with symptoms which Dr. Ernest Taylor, the medical attendant, had pronounced typical Asiatic cholera. The intestine was much congested, and contained rice water-like fluid, with numerous flakes made up of epithelial cells. In the flakes were crowds of comma-shaped and S-shaped organisms, in some places in pure cultivation. In arrangement, aspect, size, and motility they could not be distinguished from Koch's comma-bacilli. Cultivations were made in peptone salt solution, in broth, on agar, and in gelatine plates, and they all proved positive. The cholera red reaction in the peptone cultivations was very pronounced.

No. XXV. Stockton-on-Tees case.—Received on September 16th a piece of ileum. The intestine was congested, and contained pea-soup-like fluid. Microscopic examination showed numerous epithelial flakes, with crowds of various bacteria; but nothing definite as to comma-shaped bacilli could be made out. Cultivations proved negative as to comma-bacilli.

No. XXVI. St. Bartholomew's Hospital, case No. 3* (J. E. F., *æt.* 11).—On September 18th received rice water-like evacuations of a case that had been brought from Clerkenwell to the hospital with symptoms of cholera. The stool contained, in slightly turbid fluid, numerous whitish grey flakes, which, on examination, proved to be made up, not of epithelium but of leucocytes; no definite commas. Cultivations proved negative as to comma-bacilli. A rice water stool of the same case was obtained on September 19th. Greyish white flakes were numerous in it; they were not of the epithelial character, and neither they nor the fluid part of the stool contained definite comma-shaped bacilli, though there were crowds of bacillus coli. Cultivations proved, as before, negative. The patient recovered.

No. XXVII. Accrington case.—Received on September 19th a fluid stool that had been voided by an adult male on September 15th. The microscopic examination showed numerous epithelial flakes, and in them abundance of comma-shaped bacilli and S-shaped forms. Cultivations in peptone salt solution proved positive. Subcultures from these yielded typical Koch commas. Cholera red reaction distinct.

No. XXVIII. Newington (London) case.*—Received on September 19th part of the ileum of a woman (S. B.), who had died with suspicious symptoms. The intestine was much congested, and contained solid gelatinous stringy masses. Microscopic examination showed numerous epithelial flakes, with crowds of bacillus coli but no definite commas. Cultivations made in various media (gelatine plates, agar plates, peptone salt solution, broth peptone) all proved negative; no comma-bacilli made their appearance.

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* Examined for the London County Council.

No. XXIX. Blackburn case.—Received on September 20th, a pea-soup-like fluid stool of a person C. It contained crowds of various bacilli and of cocci; no definite comma-shaped organisms amongst them. Cultivations proved negative as to cholera commas.

No. XXX. Ilkeston case.—A. A., *æt.* 20, died September 19th. Received September 21st a piece of ileum, distinctly congested. Contents a brownish fluid, with numerous flakes of epithelial character, crowded with masses of cocci; here and there an undoubted comma-shaped bacillus. Cultivations in peptone salt solution yielded at once positive results. Subcultures in the different media produced crops of Koch's comma-bacillus. Cholera red reaction distinct.

No. XXXI. Liverpool case W. T. C.—Received on September 21st a fluid brownish stool, and a piece of intestine. The stool had had glycerine mixed with it, and the intestine had, after being opened, been placed in glycerine. In the stool there were found amongst crowds of different bacteria a few comma-shaped bacilli. The intestine was much congested, and flakes lifted from the internal surface showed in microscopic specimens a few undoubted commas. Cultivations were made in peptone salt solution, in gelatine plates, and in agar plates, but they all remained sterile; no growth of any kind appeared in them, thus showing that all the bacteria in the specimens had been killed by the glycerine. (*See also No. XLI.*)

No. XXXII. St. Bartholomew's Hospital, case No. 4.*—On September 21st a boy, (A. B., aged 15), was admitted from Penge (Lewisham) with suspicious symptoms and voiding copious fluid stools. Microscopic examination showed numerous flakes, but not epithelial in character they were crowded with bacillus coli. No definite comma-shaped bacilli. Cultivations proved negative. The patient recovered.

No. XXXIII. Appleton-le-Street (Malton, R.) case No. 1 (B. E.).—Received on September 22nd a fluid stool and a piece of ileum; the latter contained greyish semi fluid material. There were found both in the stool and in the intestinal contents numerous epithelial flakes, containing (especially the stool) numerous typical commas. Cultivations made in peptone salt solution yielded at once positive results. Subcultures in all the usual media afforded typical crops of Koch's comma-bacillus. Distinct cholera red reaction obtained in the peptone cultures.

No. XXXIV. Appleton-le-Street case, No. 2, G. B.—Received on September 22nd a brownish fluid stool; full of bacillus coli; with some few suspicious commas. Cultivations proved negative.

No. XXXV. Hackney case.*—Received on September 22nd from Dr. Wharry a typical rice water stool, voided on September 18th, by a patient (Thomas S.). The stool contained numerous whitish grey flakes which under the microscope did not show any epithelial cells. These flakes contained crowds of straight bacilli. Cultivations were made, but all proved negative. The patient recovered.

No. XXXVI. Great Yarmouth case No. 1.—Received on September 25th from Dr. Wrigley a piece of ileum of A. J. M., *æt.* 13, who had died September 22nd at 2.30 p.m. The intestine was congested

* Examined for the London County Council.

and contained gelatinous semi-fluid material. In this, under the microscope, extensive epithelial masses were found, which contained comma-shaped and S-shaped bacteria in great abundance and in the characteristic distribution. Cultivations were made, after a flake had been shaken up in sterile salt solution, in peptone salt tubes, in gelatine plates, in agar plates, and in broth peptone. In all these media pure crops of Koch's comma-bacillus were obtained.

No. XXXVII. Appleton-le-Street case No. 3.—Received on September 26th a dark brown fluid stool, voided by Mrs. R. on fifth day of her diarrhœa attack. The patient had been treated with large doses of carbolic acid and was recovering. The stool smelled distinctly of phenol. Microscopic examination showed, amongst large numbers of bacillis coli, a few suspicious-looking curved bacilli. Cultivations were made in peptone salt solution. They all remained sterile; no growth whatever appeared in them. It is, therefore, probable that the carbolic treatment had killed the bacteria; not only the comma-bacilli, if such were present, but also bacillus coli.

No. XXXVIII. Tividale (Rowley Regis) case.—Received on September 27th the ileum of C. B., *æt.* 47. The intestine was congested, and contained a peasoup-like fluid. Under the microscope there were seen numerous epithelial flakes, and in them crowds of comma-shaped bacilli and S-shaped forms. Cultivations in peptone salt solution produced good crops of Koch's comma-bacillus. Cholera red reaction distinct. Sub-cultures in the different media yielded pure growths of Koch's commas.

No. XXXIX. Southwark (St. George-the-Martyr) case.*—Robert W., *æt.* 60. Received, on September 27th, from Dr. Hamer a piece of ileum of the above case. The mucous membrane was deeply congested, the Peyers patches and solitary follicles very prominent, and deeply congested. The contents consisted of brownish fluid. On microscopic examination there were observed numerous epithelial flakes crowded with different bacteria, amongst which were fairly numerous commas and S-shaped forms; also free flagella. Cultures in peptone salt solution yielded at once crops of comma-bacilli. In peptone subcultures the cholera red reaction was very pronounced. The peculiar character of the growth in gelatine of the comma-bacilli obtained from this case has been already referred to; in the gelatine plate cultivations liquefaction was extremely retarded, and in gelatine stab cultures no liquefaction took place for some considerable time. Sections made, after hardening, through the congested mucous membrane of the bowel showed bacteria of different sorts situated in an almost unbroken layer on the surface of the mucosa, which was denuded of the epithelium; and showed also these organisms extending into the disorganised Lieberkuhn's follicles, and into the tissue of the mucosa. In some places comma-bacilli and S-shaped forms were found scattered and in clumps without admixture with other bacteria. (*See* Figs. 24 and 25, Plate VI.)

No. XL. Great Yarmouth (case No. 2).—Received through Dr. Copeman, on September 29th, a rice water-like stool of S. A. P., *æt.* 9. The stool consisted of slightly turbid colourless fluid, in which were suspended numerous greyish white flakes. These flakes were made up of epithelium. Both the flakes and the fluid in which they were suspended were literally crowded with Koch's commas, and, as far as appearances in cover-glass specimens went, were pure cultures of

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this bacillus. (*See* Figs. 6 and 7, Plate II.). Cultivations made in the several different media direct from this stool produced pure crops of Koch's comma-bacillus. This, therefore, was one of the minority of cases in which the stool was a pure cultivation of Koch's cholera commas. It was in fact the most typical case as regards numbers of these commas. And it was at the same time the only rice water stool in which, after filtering off the flakes, the fluid part of the specimen itself gave, on the addition of a few drops of pure sulphuric acid, a faint but distinct cholera red reaction. The patient recovered.

No. XLI. Liverpool case.—W. T. C. (*See also No.* XXXI.) Owing to the unsatisfactory state of the intestine (which had been cut open and placed in glycerine), received by me 21st September, a sealed jar was forwarded to me from Liverpool on September 29th, containing a piece of intestine from the same case. This jar had received the piece of intestine now in question on September 19th, and had been kept sealed for 10 days. On opening the intestine (September 29th) I found its mucous membrane congested but no fluid in it; the epithelium was loosely attached to the mucous membrane, and easily came off in large masses. Microscopic examination showed, amongst numerous specimens of bacillus coli and proteus, a fair number of comma-bacilli and a considerable number of free flagella. Cultivations were made in peptone salt solution, and these yielded at once a crop of Koch's comma-bacillus. Subcultures made therefrom in the several different media produced pure growths of typical cholera comma-bacilli. The cholera red reaction in the peptone cultures was very pronounced.

No. XLII. Malling (R.) case.—Received on September 29th a piece of bed sheeting, supposed to have been saturated with the rice-water discharges of a patient (E. F., *æt.* 43) who had died with suspicious symptoms. The stained portions of the sheeting, to which adhered a few flocculi, were put in sterile salt solution, and from this mixture coverglass specimens were made. Result, doubtful. Cultivations were made at the same time, but they all remained sterile; no growth of any kind appeared in them. It ought to be stated that the sheeting smelled strongly of phenol, and it is therefore probable that all organisms in the specimen had been killed thereby. Hence, perhaps, the sterility of the inoculated media.

No. XLIII. Coton Hill case.—On October 2nd I received from the Coton Hill Asylum (Stafford R.) a piece of ileum of a male, *æt.* 56. This intestine was much congested and contained fluid floccular grumous matter. Under the microscope the flakes were seen to consist of epithelial cells, and in the flakes, as also in the fluid parts of the material, large numbers of comma-shaped bacilli and S-shaped forms were found. Cultivations made in peptone salt solution yielded positive results in 12 hours; also distinct cholera red reaction. Subcultures made in the different media produced pure crops of Koch's comma-bacillus.

No. XLIV. Gloucester case.—Received from Dr. Campbell on October 5th a piece of ileum of C. W., *æt* 64. The ileum was much congested; in its cavity was a fluid brownish material. Under the microscope large flakes were seen to be made up entirely of epithelial cells, with numerous small bacilli (bacillus coli) in clumps and in streaks; no commas. Cultivations did not yield commas, but produced pure growths of bacillus coli.

No. XLV. North Bierley (case No. 1.)—Received on October 6th a piece of ileum of a youth (E. W., *æt.* 20), who had died after having been ill for 10 days from what was suspected to be cholera. The intestine was deeply congested; a Peyers patch and some solitary glands were deep purple. In the interior of the ileum there was no fluid, but a white slimy layer of brownish material adhered to its wall. Microscopic examination gave no definite result; but there were amongst a crowd of bacilli some that looked like commas. Cultivations gave negative results.

No. XLVa. North Bierley (case No. 2).—Received through Dr. Bulstrode on October 9th the rice-water stool of a woman, Mrs. L., the subject of supposed cholera. The stool presented all the essential characters of a cholera stool. It was a colourless fluid, in which were numerous large and small greyish-white flakes. These under the microscope were seen to consist of epithelial cells. Numerous commas, S-shaped bacteria, and free flagella were present in the fluid and in the flakes; the latter especially were crowded with them in clumps and in streaks. Cultivations yielded at once positive results; pure crops of Koch's commas were obtained in peptone salt solution, in gelatine plates, in broth peptone and on agar, by direct inoculation with the flakes diluted in salt solution. The cholera red reaction, too, was distinct in the peptone cultures.

No. XLVI. Dr. Reece handed to me on October 9th a stool of a case, Mrs. B., from Grimsby.—The stool was a brownish fluid. Microscopic examination and cultivations yielded negative results.

No. XLVII. On the same date, October 9th, Dr. Reece brought me from the fever hospital, Grimsby, a stool of another case (G. L.).—This stool was a brownish fluid, containing numerous epithelial flakes. There were present in the microscopic specimens numerous free flagella. Cultivations proved negative as to Koch's comma-bacillus.

No. XLVIII. Ormskirk case.—Received on October 9th a stool of a patient (P. K., *æt.* 33) sent by Dr. Hanly. The stool was of a brownish colour, semi-fluid in character, and of fœcal colour. Microscopic specimens showed amongst crowds of bacteria some few that looked like commas, and also a few free flagella. Cultivations, however, proved negative. (*See also No. L.*).

No. XLIX. Hartley Wintney (R.) case.—Received on October 10th stool of a case (8.). The stool was fluid, of a whitish-yellow colour. It contained crowds of bacteria, amongst them a few apparently comma-shaped. Cultivations proved negative.

No. L. Ormskirk case. (*See also No. XLVIII.*)—Received on October 11th a piece of ileum (tied at both ends) which had evidently been kept in spirit. It was congested. In its interior was brownish fluid matter, in which, under the microscope, epithelial flakes could be recognised; but nothing definite was observed as to the presence of comma-shaped bacilli. Cultivations were made in peptone salt solution, but the tubes of this medium remained sterile; no growth appeared in them. This result was evidently owing to the fact that the added spirit had killed the organisms present in the intestine.

No. LI. Balby (Doncaster, R.) case.—Received, on October 11th, a stool of a boy, H. L. The stool was of a typical rice-water

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character. This slightly turbid colourless fluid showed numerous greyish white, large and small, epithelial flakes. Microscopic and cultural examination of these flakes proved this case to be true cholera. The material, in fact, next to Great Yarmouth case No. 2, was most characteristic of cholera: it afforded too Koch's comma-bacillus almost in pure culture. (*See* Fig. 8, Plate II.)

No. LII. Rawmarsh case.—Received on October 11th a piece of ileum of a person (M. A. M., *æt.* 42) supposed to have died from cholera. The intestine was congested, and contained rice water-like fluid. Microscopically this fluid was found to contain flakes which consisted of epithelial cells; and in these flakes were crowds of commas and S-shaped bacteria—in clumps and in streaks, almost in a pure culture. Cultivations in peptone salt solution, in gelatine plates, and on agar (made in each instance from a flake distributed in sterile salt solution), yielded pure cultures of Koch's commas. Cholera red reaction was distinct in these peptone cultures after only six hours' incubation.

No. LIII. Warrington case.—Received on October 17th a stool of a patient (T. J., *æt.* 30), and on October 18th a piece of intestine from the body of this person. The stool was a whitish colour, and contained but few flakes, not of epithelial character. There were present in its crowds of different bacteria, none of which could be recognised as commas, although there were present numerous free flagella. The intestine was deeply congested, and contained reddish thick mucoid matter; no definite comma-bacilli. Cultivations were made of the stool and of the intestinal contents, but they proved negative as regards comma-bacilli.

No. LIV. Bingley (Township) case.—Received on October 18th a bottle containing two or three greyish-looking mucus flakes and brownish fæcal masses derived from the bowels of a person who had died with suspicious symptoms. The microscopic examination showed numerous small epithelial masses, containing, amongst a crowd of various bacteria, some bacilli that looked like commas. Cultivations in peptone salt solution yielded at once crops of comma-bacilli, which in subcultures proved to be Koch's commas. Cholera red reaction distinct.

No. LV. Keighley case.—Received on October 26th, from Dr. Scatterly, a piece of ileum (tied at both ends) of Mrs. B. The intestine was much congested; it contained no fluid. The epithelium was only loosely adhering, and was easily detached. In microscopic specimens these detached masses were seen to contain numerous bacteria, but nothing definite as to comma-shaped bacilli. Cultivations were made in peptone salt solution, which, after 12 hours, yielded a crop of comma-bacilli. These, in subcultures in the various media, proved identical with Koch's commas; cholera red reaction distinct after 12 hours.

III.—Summary of Results.

In proceeding to summarise the facts that I have recorded it is necessary to note, in the first place, that the 56 samples of material enumerated refer to 53 cholera cases, or quasi-cholera cases, only.*

* Nos. XLV. and XLV. (*a*) refer to separate cases; while Nos. XIX. and XXI., Nos. XXXI. and XLI., and Nos. XLVIII. and L. refer in each instance to a single case.

Secondly, it has to be noted that in 6 of the 53 cases which came under examination the material submitted had either been previously subjected to germicidal influences (Nos. VIII., XXXVII., XLII., and XLVIII. with L.), or had been obtained at so late a stage of the malady that was in question (Nos. XI. and XLV.) as to render negative evidence of a bacteriological sort of no particular value.* There remain, therefore, 47 cases to be accounted for.

Of the 47, in 30 (63·8 per cent.) positive evidence was forthcoming —by microscopic examination of the raw material, by cultural test of such material, or by both processes—that the cases in question were true cholera. In the remaining 17 (36·2 per cent.) the evidence was from the bacteriological view point generally of a negative character.

As to the nature of the evidence affirmative of cholera:—Of the 30 positive cases, in no less than 15 (Nos. I., II., III., IV., V., VI., XII., XIV., XXIV., XXVII., XXXVI., XL., XLV.(*a*), LI., and LII.) *the microscopic characters alone* of the material submitted to me—rice-water stool or contents of ileum—sufficed to establish bacterioscopically a diagnosis of true cholera.† In the other 15 of these 30 cases (Nos. IX., X., XIII., XV., XVII., XVIII., XXII., XXX., XXXIII., XXXVIII., XXXIX., XLI., XLIII., LIV., and LV.) *the culture tests* yielded positive results, notwithstanding that the microscopic appearances of the raw material had been equivocal or even negative.

IV.—Inferences.

With reference to the significance of the flakes present in the stools and in the intestinal contents, I would point out that in every one of the cases in which the cultures yielded positive evidence as to the presence of Koch's comma-bacillus, the stools or intestinal contents had showed flakes composed of epithelium which had become detached from the mucous membrane. It is true that out of 17 cases in which cultivation proved negative as regards comma-bacilli, there were flakes present in ten:—in four,‡ epithelial flakes; in six,§ flakes containing leucocytes only. But of the four containing epithelial flakes, no less than three were fatal; whereas all six cases in which the flakes contained only leucocytes recovered. Hence there can be no question that the presence of *epithelial* flakes in a stool derived from a patient suffering from symptoms indicative of choleraic disease is a very suspicious circumstance. Whether or not it be regarded as significant that the disease is Asiatic cholera, it is at least indicative that the prognosis respecting the case is a grave one.

As to the value for purposes of diagnosis of the demonstrated presence or absence of Koch's comma-bacilli in the stools or in the contents of the intestines, I must once more insist on the fact that in the present state of our knowledge the demonstration by culture of the

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* It is admitted by Koch and other observers that in cholera cases of three or four days' duration the comma-bacilli tend to disappear from the intestine, or at any rate cannot be demonstrated in culture.

† As regards no less than eight of the fifteen cases in question, the raw material submitted contained Koch's comma-bacilli in abundance, and to the exclusion (or almost to the exclusion) of other micro-organisms.

‡ Nos. XXV., XXVIII., XLIV., and XLVII.

§ Nos. VII., XVI., XXIII., XXVI., XXXII., and XXXV.

App. B. No. 17. Observations on reported Cholera Material sub-mitted for examination by Dr. Klein, F.R.S.

presence of Koch's comma-bacillus is in the highest degree significant. As I have said, in no acute disease of the intestine in the human subject, except Asiatic cholera, is this species (answering to each of the various culture tests I have enumerated) known to occur. In papers that I wrote so long ago as 1886–87* I gave very definite expression to this view. I stated:† "One thing, however, may be said with "certainty, namely, that so far as our limited knowledge at present "goes, in no intestinal disorder in man (except true cholera) "have comma-bacilli behaving in artificial cultures like those of "Asiatic cholera been yet found in the intestinal evacuations." And again:‡ "Hence I agree with the proposition that if in any case "of diarrhœa the choleraic comma-bacilli can be shown both by the "microscope and by culture experiments to exist, then the suspicion "that it may be a case of Asiatic cholera is quite justified." It must be clear from this that if I still (1893) adhere to this proposition, I am not to be justly accused of having altered my former opinion. As previously, so also now, I fully endorse Koch and all who have had practical experience of cholera as to the diagnostic value of the cholera comma-bacilli.

A more important question is the diagnostic value in a negative sense of the absence of Koch's comma-bacillus in cases suspected to be Asiatic cholera. From facts within my own experience, some of them referred to in previous pages, I am inclined to agree with those observers who found that in localities and at times when cases of undoubted Asiatic cholera were present, there occur cases in which the history, symptoms, fatal issue, and pathology show them to be true cholera, notwithstanding that Koch's comma-bacillus cannot be demonstrated in the stools or in the intestinal contents by microscopic examination or by the culture tests.§ These facts appear to me now, as formerly, to conduce to hesitation in accepting Koch's comma-bacillus as the one essential factor in the causation of Asiatic cholera.

A further point of importance, to which attention was first directed by Dr. D. D. Cunningham, is the now admitted—though at first strenuously denied—fact that the cholera comma-bacilli isolated from different cases are not precisely the same. They differ from one another in some marked respects, so that at the very least they represent different varieties if not distinct species. This again is consistent with their being less directly related to the disease than has been accepted as proven.

Finally, as to the intraperitoneal virulence in guinea-pigs of the cultures of comma-bacilli from cholera cases. This, as I have shown, does not necessarily support the view that the comma-bacilli are the cause of Asiatic cholera; for in the first place the disease thus produced in the guinea-pig is acute peritonitis and not cholera, and in the second place a variety of other microbes injected in the same manner into the

* Reprinted in book form, and entitled "The Bacteria in Asiatic Cholera," Macmillan & Co.

† *l.c.*, page 114.

‡ *l.c.*, page 115.

§ In Hamburg (Hueppe) in August and September 1892; in Russia 1892 (Nencki and his pupils); in Paris 1892 (Peter and others); not to go back to the epidemic of cholera in Spain in 1886 (Roy, Brown, and Sherrington). Professor Virchow, too, on his return from a visit to Russia (autumn 1892) distinctly warns against the Berlin method as to describing as cholera nostras, cases in which the comma-bacilli are not found.

guinea-pig produce clinically the same disease, with identical pathological appearances. These points, however, I have fully discussed in my Report on "Antagonisms of Microbes" for 1892–93.*

I append a tabular statement with regard to the microscopic and bacteriological examination of the 30 positive cases.

* Report of the Medical Officer of the Local Government Board, 1892–93, pp. 367–389.

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Observations on reputed Cholera Material submitted for examination; by Dr. Klein F.R.S.

Tabular Statement of the Results of Examination of

No.	A. Derivation of Material.	B. Microscopical Characters of Stool or of Intestinal Contents.	C. General Characters of Cultures.	D. Cholera Red Reaction.
I.	Hull, No. 1	Typical	Positive	Distinct
II.	Grimsby, No. 1	„	„	„
III.	Grimsby, No. 2	„	„	„
IV.	Hull, No. 2	„	„	„
V.	Rotherham	„	„	„
VI.	Westminster	„	„	„
IX.	Boston	Not altogether typical.	„	„
X.	Morton (Gainsboro' R.)	„ „ „	„	„
XII.	Leicester	Typical	„	„
XIII.	Handsworth	Doubtful	„	„
XIV.	Retford	Typical	„	„
XV.	Fulham	Not typical	„	„
XVII.	Kennington (Lambeth)	„	„	„
XVIII.	Ashbourne	„	„	„
XXII	Croydon Borough	„	„	„
XXIV.	Derby	Typical	„	„
XXVII.	Accrington	„	„	„
XXX.	Ilkeston	Not typical	„	„
XXXIII.	Appleton-le-Street, No. 1	Fairly typical	„	„
XXXVI.	Great Yarmouth, No. 1	Typical	„	„
XXXVIII.	Tividale (Rowley Regis)	Fairly typical	„	„
XXXIX.	Southwark (St. George-the Martyr).	Not typical	Not liquefying gelatine in stab, slowly liquefying in plate culture.	„
XL.	Great Yarmouth, No. 2	Typical	Positive	„
XLI.	Liverpool	Not typical	„	„
XLIII.	Coton Hill (Stafford R.)	Fairly typical	„	„
XLV(a).	North Bierley, No. 2	Typical	„	„
LI.	Balby (Doncaster R.)	„	„	„
LII.	Rawmarsh	„	„	„
LIV.	Bingley (Township)	Not typical	„	„
LV.	Keighley	Doubtful	„	„

Material, obtained from the 30 positive Cases.

E. Growth in Gelatine Stab Culture	F. Growth in Potato Culture at 37° C.	G. Milk Culture at 37° C.	H. Amount of Agar Culture required for production, by Intra-peritoneal Injection, of Fatal Result in Guinea-pigs.
Liquefied fairly quick; good pellicle.	No growth after 10-14 days.	Coagulated after 11 days	$\frac{1}{8}$ of a tube.
„ „ „	Light yellow after 14 days	Fluid after 14 „	$\frac{1}{8}$ „
Liquefies quickly; no pellicle	No growth after 14 „	Coagulated after 6 „	$\frac{1}{10}$, $\frac{1}{4}$ „
„ „ „	„ 14 „	„ 11 „	$\frac{1}{8}$ „
„ „ slight pellicle	„ 14 „	Fluid after 14 „	Not tested.
„ „ „	„ 14 „	„ 14 „	$\frac{1}{8}$ of a tube.
Fairly quick; good pellicle	„ 14 „	„ 14 „	Not tested.
„ no pellicle	Light yellow after 14 „	Coagulated after 5 „	„
Moderate; good pellicle	„ brown after 5 „	„ 5 „	$\frac{1}{8}$ of a tube.
Fairly quick; slight pellicle	No growth after 14 „	Fluid after 14 „	Not tested.
Moderate; slight pellicle	„ 14 „	Coagulated after 5 „	„
Fairly quick; good pellicle	„ 14 „	Fluid after 14 „	$\frac{1}{10}$, $\frac{1}{4}$ of a tube.
Quick; slight pellicle	„ 14 „	Coagulated after 6 „	$\frac{1}{10}$, $\frac{1}{4}$ „
Slow; no pellicle	„ 14 „	„ 10 „	$\frac{1}{10}$, $\frac{1}{4}$ „
Quick; good pellicle	„ 14 „	„ 6 „	Not tested.
„ no pellicle	„ 14 „	Fluid after 14 „	$\frac{1}{8}$ of a tube.
Slow; good pellicle	Light yellow after 5 „	„ 14 „	$\frac{1}{8}$ „
„ „	„ 5 „	„ 14 „	Not tested.
Fairly quick; good pellicle	No growth after 14 „	Coagulated after 10 „	„
„ „ „	„ 14 „	„ 11 „	$\frac{1}{8}$ of a tube.
Slow; no pellicle	„ 14 „	„ 5 „	Not tested.
Not liquefying	„ 14 „	Fluid after 14 „	$\frac{1}{8}$ of a tube.
Quick; slight pellicle	„ 14 „	Coagulated after 11 „	$\frac{1}{10}$, $\frac{1}{4}$ „
Fairly quick; good pellicle	„ 14 „	„ 5 „	Not tested.
Moderate; good pellicle	Light yellow after 5 „	„ 10 „	$\frac{1}{8}$ of a tube.
Quick; no pellicle	No growth after 14 „	„ 14 „	Not tested.
„ slight pellicle	„ 14 „	„ 5 „	„
„ good pellicle	„ 14 „	„ 5 „	„
Very quick; no pellicle	„ 14 „	„ 6 „	„
„ „	Light yellow after 14 „	„ 6 „	$\frac{1}{10}$, $\frac{1}{4}$ of a tube.

App. B. No. 17. Observations on reputed Cholera Material submitted for examination; by Dr. Klein, F.R.S.

Report on Samples of Water derived from Localities in which cases of Cholera had been occurring; by Dr. Klein, F.R.S.

A. Water from Sutton Dyke at Hull.

On September 1st Dr. Theodore Thomson brought to me two bottles of water derived from the "Sutton Dyke" at Hull. This water was turbid owing to the presence of numerous brownish particles and greyish translucent flocculi. Coverglass specimens were made from the water, after shaking it up, in the following manner. Two to five drops were deposited in the middle of a coverglass and rapidly dried over the flame; then stained, washed, and mounted. In this way all the organisms present in the above quantity were brought to view within a comparatively small area. As far as shape is concerned there could be made out amongst the very considerable number of bacteria present the following forms:—

(*a*) Cocci, singly or in dumb-bells (diplococci);
(*b*) Cylindrical rods of various length, thin;
(*c*) Cylindrical rods of various length, thick;
(*d*) Short oval bacteria; and
(*e*) distinctly comma-shaped forms.

The latter were in some places very abundant, forming small groups, and between the groups were isolated commas. In size the commas were not unlike those of cholera.

Cultivations were next made:—(*a*) in peptone salt solution; and (*b*) in gelatine plates. For each tube and each plate 1 to 5 drops of the water were used. The peptone tubes were incubated at 37° C., the gelatine plates at 20° C.

After 24 hours incubation there was turbidity in the peptone tubes. Taking therefrom, out of the superficial layer at this stage, a small droplet, making therewith a cover-glass film preparation, and staining and mounting it, numerous commas and S-shaped forms were seen, as well as some straight cylindrical bacilli both thick and thin. The comma-bacilli in some regions of the cover-glass specimen seemed almost in pure culture.

From the same peptone tube a droplet was taken, and placed, for the sake of dilution, in about 10 cc. of sterile salt solution, and of this mixture traces were deposited by a platinum needle in fresh peptone tubes, and in gelatine for plate cultivation. In the secondary set of peptone tubes, after 24 hours' incubation, an almost pure cultivation of the above commas was obtained; likewise in the secondary gelatine plates. As regards motility, size, and the S-shaped and spiral forms, no difference could be seen between the comma-bacilli (*see* Fig. 19, Plate V.), thus obtained from the Sutton Dyke water, and those obtained from cholera cases. But on studying more carefully in cultivation this "Hull water comma-bacillus," the following differences could be established:—

(1.) The Hull water commas grew very much more rapidly in gelatine than Koch's cholera commas. In Figs. 1, 2, 3, 4, and 5, Plate XIII., gelatine stab cultivations are shown after 24, 48, and 96 hours incubation at 20° C. It will be noticed that the rapidity of growth of, and liquefaction by, this bacillus is very great, greater even than that of Finkler's comma-bacillus; there is formed, in four days, on the surface of the liquefied gelatine a distinct pellicle.

(2.) In gelatine plate cultivation, although the general character of the colonies (liquefying character, central whitish granular deposit), is similar to that of Koch's commas, the rapidity of liquefaction by the

growth is very much greater. Further, in connexion with many of the colonies appearing in the gelatine plate, there is present a distinct gas bubble, which enlarges with the enlargement of the colony. (*See* Figs. 1, 2, and 3, Plate XVII.).

(3.) In peptone salt cultivations incubated at 37° C., the turbidity and growth is not by any means so copious and rapid with the Hull water comma as with Koch's cholera comma; besides the turbidity produced by the latter is uniform, whereas that produced by the Hull water comma is not. After some days, the Hull water comma forms greater turbidity in the top layers than in the depth; in the latter situation it is only evident in the form of small granules. It grows faster in peptone at 20° C. than at 37° C.

(4.) On agar at 37° C. no difference is to be observed.

(5.) On potato and in milk. On potato kept at 20° C., the growth assumes after two to three days incubation a light but distinct yellow brown tint; at 37° C. a colourless thinner film. Milk at 20° C. is coagulated after 48 hours; incubated for equal time at 37° C. the milk is fluid, but in an additional day is also coagulated.

With regard to the cholera red reaction, peptone cultures at 20° C. after 48 hours (there being then a fair amount of growth) give a faint rose colour on addition of sulphuric acid. But the tint is less deep than in peptone cultures of Koch's commas.

Agar cultures of the Hull water bacillus were used for intraperitoneal injection of guinea-pigs, $\frac{1}{2}$ and $\frac{1}{4}$ the scrapings of a tube being used for different animals. Both were dead next morning with intense peritonitis, and the copious peritoneal fluid was crowded with the comma-bacillus that had been injected.

On the whole then the Hull water comma-bacillus is not, in view of these facts, to be accepted as culturally identical with Koch's cholera comma-bacillus. On the other hand, it is impossible to deny that these Hull vibrios and Koch commas may be samples of the same organism in different phases. The Hull water comma-bacillus may be, for all we know to the contrary, Koch's bacillus modified by existence for a considerable space of time outside the animal body.

Sanarelli* believes that certain comma-bacilli found by him in Seine water and elsewhere, and which differed in some points from Koch's cholera vibrio, had nevertheless been derived from cholera dejecta voided during the previous year. He considers that Koch's comma-bacillus having lived for a length of time an abnormal existence—to wit, in water—may have degenerated, and have become altered in some of its cultural characters. But of course this is mere surmise; as yet it is neither proved nor disproved. As far as the facts go in this particular instance, it is only safe to say that differences do certainly exist between the Koch's comma-bacillus and the Hull Dyke water comma similar in kind to those existing between Koch's cholera comma and Sanarelli's water comma.

From the Hull Dyke water, besides the comma-bacillus above mentioned, I isolated the following species of bacteria: (*a*) bacillus fluorescens liquescens; (*b*) proteus vulgaris (*c*) bacillus coli; (*d*) various species of cocci.

B.—*Water taken from a Well at Ashbourne believed to have been concerned in Dissemination of Cholera.*

This water was received on September 15th. It was turbid and contained brownish sediment. On shaking, numerous flocculi appeared suspended in it.

* Annales de l'Institut Pasteur, November 1893.

Coverglass specimens made in the manner above described—3–5 drops allowed to dry on the centre of a coverglass—showed a considerable number of distinct commas and S-shaped forms, besides cocci and oval and cylindrical bacilli of different thickness. Cultures made in peptone salt solution, by addition to each tube of one drop of this water, yielded in 24 hours, in their superficial layers, a crop of comma bacilli which, on subcultures in peptone salt solution and in gelatine plates, proved to be Koch's comma-bacillus in pure culture. These subcultures responded indeed to all those tests which characterise the cholera-bacillus, and which have been fully described and illustrated in the preceding pages. Here it will be enough to note that in the original peptone cultures the comma-bacilli isolated from the Ashbourne water were morphologically and culturally (with inclusion of distinct cholera red reaction) identical with those obtained from the contents of the intestine of cholera patients.

By gelatine plate culture, bacillus coli, bacillus fluorescens liquescens, and proteus vulgaris were also isolated from this Ashbourne water.

C.—*Well Water from Appleton-le-Street* (*Malton R.*).

Examination of this water did not yield positive results. Large numbers of cultivations were made in peptone salt solution and in gelatine plates, but no comma-bacilli were obtained.

D.—*Well Water taken from Tap in Nottingham Road, Borough of Ilkeston.*

Here also cultivations in peptone salt solution, and in gelatine plates failed to yield any micro-organisms in shape and character resembling comma-bacilli.

I append in tabular form the results of my examination of water samples from the Sutton Dyke, at Hull, and from the Ashbourne well :—

Derivation of Sample.	General Result of Culture.	Growth in Gelatine-Stab Culture.	Growth in Potato Culture.	Milk at 37° C.	Amount of Agar-Culture required for production, by Intra-peritoneal Injection, of Fatal Result in Guinea-pigs.
Hull (Sutton Dyke).	Grows best at 20° C.	Very quick; good pellicle.	Light brown at 20° C.	Coagulated in 2–3 days.	½ of a tube.
Ashbourne well	Positive in all media.	Slow; no pellicle.	No growth at 37° C.	Fluid after 14 days.	½ "

PLATE I.

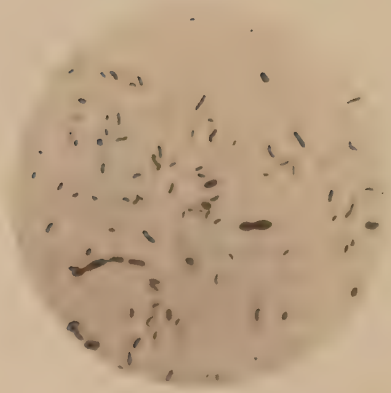

Fig. 1.

Fig 2.

Fig. 3.

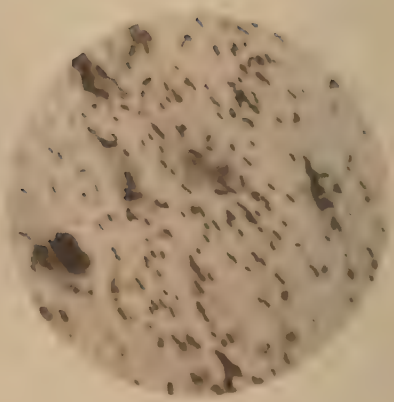

Fig. 4.

BACTERIOLOGY OF CHOLERA.

PLATE I.

FIG. 1.

Reproduced from a photograph* of a cover-glass specimen of an epithelial flake derived from a *rice-water stool* of the Westminster case (No. VI.). A large number of typical *comma-bacilli* are here seen. Also a number of *flagella*; some free, some still attached to the vibrios.

FIG. 2.

A similar specimen from the same source, showing the *comma-bacilli* almost in pure culture; also flagella.

FIG. 3.

Another specimen from the same source, showing the characteristic "fish-in-stream" arrangement of the vibrios, one of which is seen to possess a flagellum.

FIG. 4.

Reproduced from a photograph of a cover-glass specimen of an epithelial flake from the *intestinal contents* of the Westminster case. The *comma-bacilli* are here seen in pure culture, and distributed in characteristic fashion.

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* The photographs for this Volume were taken by Mr. E. C. Bousfield. Unless otherwise stated, the magnifying power is 1,000.
The "reproductions" of the photographs are by the Autotype Company

BACTERIOLOGY OF CHOLERA.

PLATE II.

FIG. 5.

Reproduced from a photograph of a cover-glass specimen of the *contents of the intestine* of the Fulham case (No. XV.). Amongst the numerous bacteria present in the specimen, some are seen to be comma-shaped, and there are also numerous flagella.

FIG. 6.

Reproduced from a photograph of a cover-glass specimen of the *contents of the intestine* of a Yarmouth case (No. XXXVI.). The *comma-bacilli* appear here in pure culture.

FIG. 7.

Reproduced from a photograph of a cover-glass specimen of an epithelial flake from the *rice-water stool* of a Yarmouth case (No. XL.). Here again the *comma-bacilli* appear in pure culture.

FIG. 8.

Reproduced from a photograph of a cover-glass specimen from the *stool* of the Balby case (No. LI.). The *comma-bacilli* appear in pure culture. Also there are seen numerous flagella; some free, some attached still to the vibrios.

PLATE II.

FIG. 5.

FIG. 6.

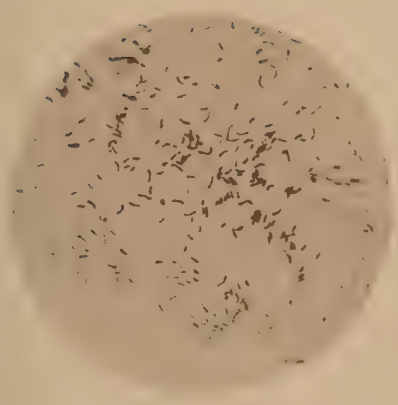


FIG. 7.

FIG. 8.

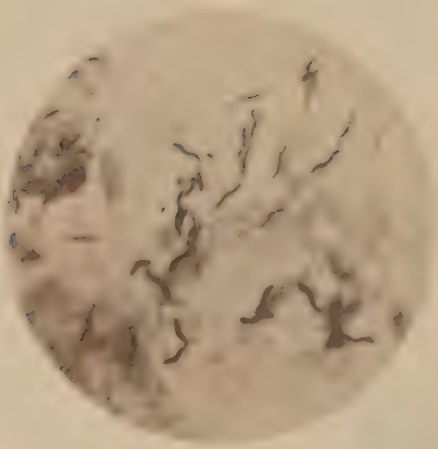


Fig. 9.

Fig. 10.

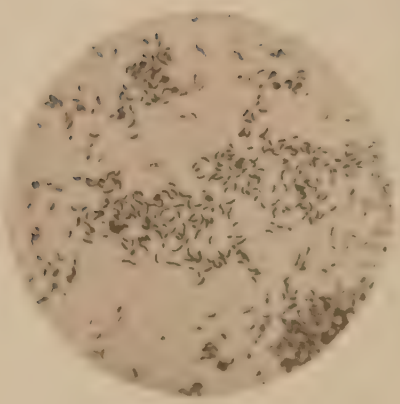


Fig. 11

Fig. 12

BACTERIOLOGY OF CHOLERA.

PLATE III.

FIG. 9.

Reproduced from a photograph of a cover-glass specimen from the *stool* of the Balby case (No. LI.). There is here exhibited another form of vibrio than that shown in Fig. 8 (Plate II.). It is much larger, for instance, as well as spirillum-like; flagella are also seen.

FIG. 10.

Reproduced from a photograph of a cover-glass specimen of an *epithelial flake* derived from an Appleton-le-Street case (No. XXXIII.). The specimen is typical of cholera; the *comma-bacilli* appearing in pure culture and distributed in the characteristic "fish-in-stream" arrangement.

FIG. 11.

Reproduced from a photograph of a cover-glass specimen from an *agar culture* of the vibrio of the above Appleton-le-Street case (No. XXXIII.).

FIG. 12.

Reproduced from a photograph of a cover-glass specimen from the *contents of the intestine* of the Rotherham case (No. V.). The *comma-bacilli*, though not numerous, were in pure culture in this specimen.

BACTERIOLOGY OF CHOLERA.

PLATE IV.

FIG. 13.

Reproduced from a photograph of a cover-glass specimen of an *epithelial flake* from the Rawmarsh case (No. LII.). The *comma-bacilli* are in pure culture, and exhibit the characteristic "fish-in-stream" arrangement.

FIG. 14.

Reproduced from a photograph of a cover-glass specimen from the *intestinal contents* of the Liverpool case (No. XLI.). Numerous flagella are here seen.

FIG. 15.

Reproduced from a photograph of a cover-glass specimen of the pellicle of a *broth culture* derived from the Retford case (No. XIV.). Spirilla-like forms, unsegmented, are here seen.

FIG. 16.

Reproduced from a photograph of a cover-glass specimen of the pellicle of a *broth culture* derived from the 2nd Yarmouth case (No. XL.). Here again spirilla-like forms are seen, but they are distinctly segmented.

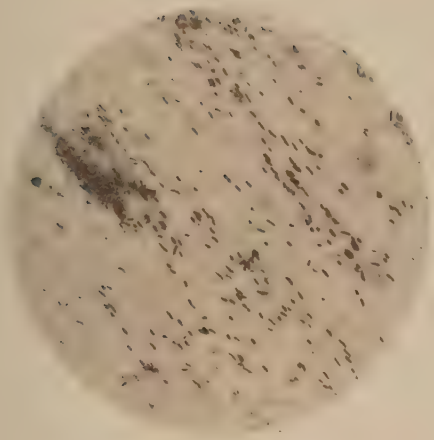


FIG. 13.

FIG. 14.

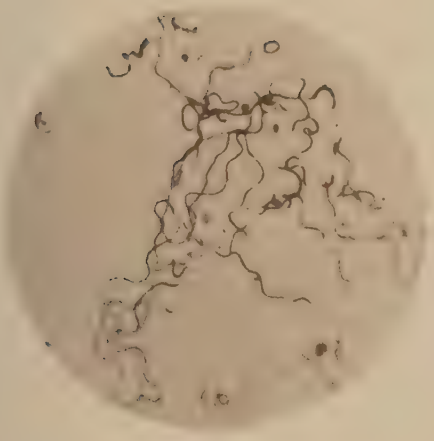


FIG. 15.

FIG. 16.

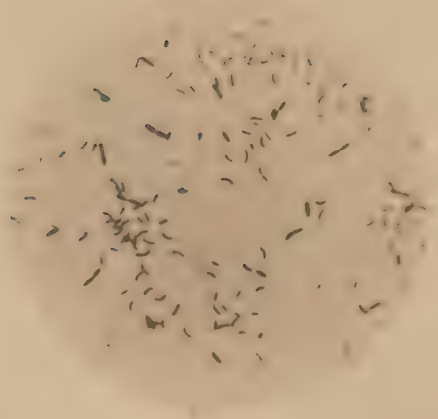


Fig. 17.

Fig. 18.

Fig. 19.

Fig. 20.

BACTERIOLOGY OF CHOLERA.

PLATE V.

FIG. 17.

Reproduced from a photograph of a cover-glass specimen of a *flocculus* from the water of the *Ashbourne well*. Abundance of comma-bacilli are here seen.

FIG. 18.

Sample from a *culture in peptone salt solution* of the comma-bacillus derived from the water of the Ashbourne well.

FIG. 19.

Reproduced from a photograph of a cover-glass specimen of *comma-bacilli* from a culture *in peptone salt solution*, derived from the water of Sutton Dyke, Hull.

FIG. 20.

Reproduced from a photograph of a cover-glass specimen from a *stool* of a person attacked by diarrhœal illness in Greenwich Union Workhouse. Threads of *cylindrical bacilli* are here seen.

BACTERIOLOGY OF CHOLERA.

PLATE VI.

FIG. 21.

Reproduced from a photograph of a cover-glass specimen of *culture* in *peptone salt solution* of material from a stool, referred to under Fig. 20, as voided by one of the Greenwich Workhouse cases. The bacilli here seen are identical with those depicted in Fig. 20, Plate V.; their bipolar staining was well marked.

FIG. 22.

Sample of bacilli of similar description from a culture derived from another Greenwich Workhouse case.

FIG. 22 (A).

Specimen of a section through the *kidney* of one of the Greenwich Workhouse cases; showing clumps of the above bacilli.

FIG. 23.

Reproduced from a photograph of a cover-glass specimen from a culture in *peptone salt solution* of *comma-bacilli* from the water of the Greenwich Workhouse well.

FIG. 24.

Section* through the mucous membrane of the *ileum* of the Southwark case (No. XXXIX.). It shows masses of detached epithelium from a Lieberkühn follicle, with numerous *comma-bacilli* between the masses.

FIG. 25.

The same specimen under the higher magnifying power.

* Magnifying power 650.

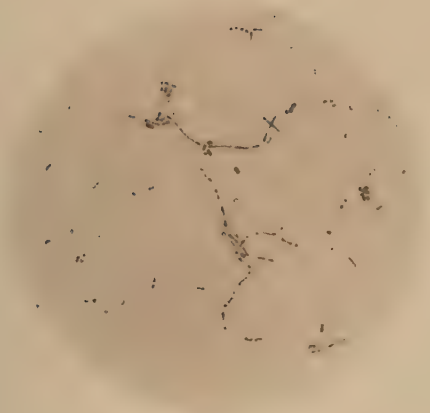


FIG. 21.

FIG. 22.

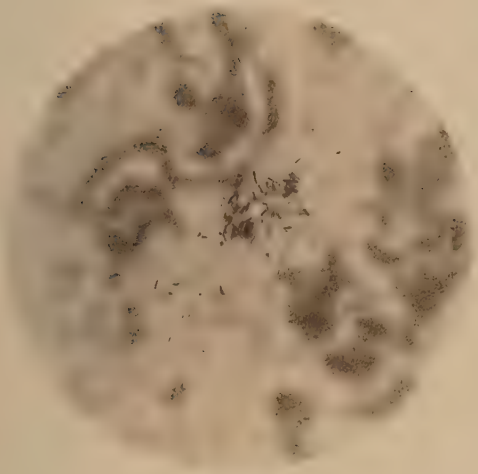


FIG. 22*a*.

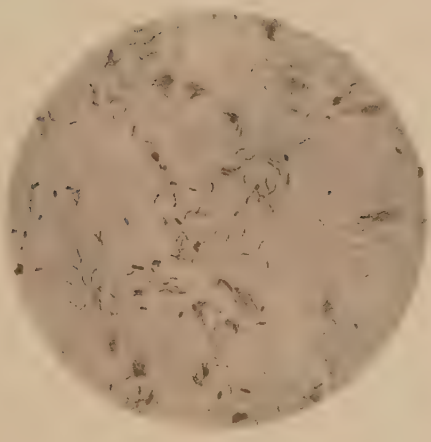


FIG. 23.

FIG. 24.

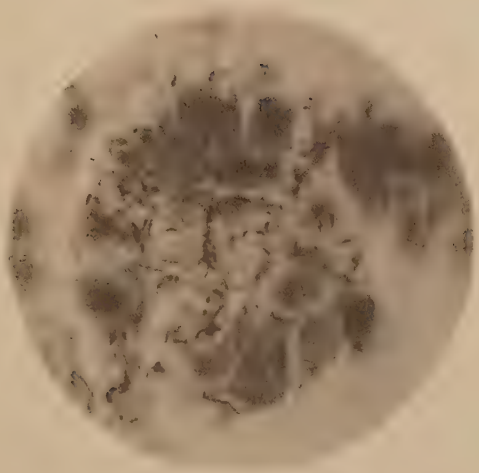


FIG. 25.

Hull I
after 8 days
Grimsby I
after 8 days
Grimsby II
after 8 days
Hull II
after 8 days
1
2
3
4
Rotherham
after 8 days
Westminster
after 7 days
Boston
after 7 days
Gainsboro
after 7 days
5
6
7
8

BACTERIOLOGY OF CHOLERA.

PLATE VII.

[NOTE.—The drawings in this and in succeeding plates (up to and inclusive of Plate XII.) represent *stab-cultures* in gelatine of the comma-bacilli obtained from different samples of cholera material examined by me in 1893. These drawings enable comparison to be made, as regards rapidity of growth and liquefaction of the gelatine, between comma-bacilli from the different sources. The gelatine medium used was in every instance of precisely the same composition, and in all the subcultures depicted the contained comma-bacilli were an equal number of removes from the raw material whence they were derived. The gelatine medium was inoculated in each instance by a single stab, and all the subcultures were incubated at 20° C.—E.K.]

Fig. 1. Hull (1); No. I. in the text of this report.
Fig. 2. Grimsby (1); No. II. ,, ,,
Fig. 3. Grimsby (2); No. III. ,, ,,
Fig. 4. Hull (2); No. IV. ,, ,,
Fig. 5. Rotherham; No. V. ,, ,,
Fig. 6. Westminster; No. VI. ,, ,,
Fig. 7. Boston; No. IX. ,, ,,
Fig. 8. Morton (Gainsborough Rural); No. X. in the text of this report.

Rotherham and Grimsby (2) afford instances of comma-bacilli rapidly liquefying the gelatine. In the case of Morton (Gainsborough Rural), the process is observed to be much more slow.

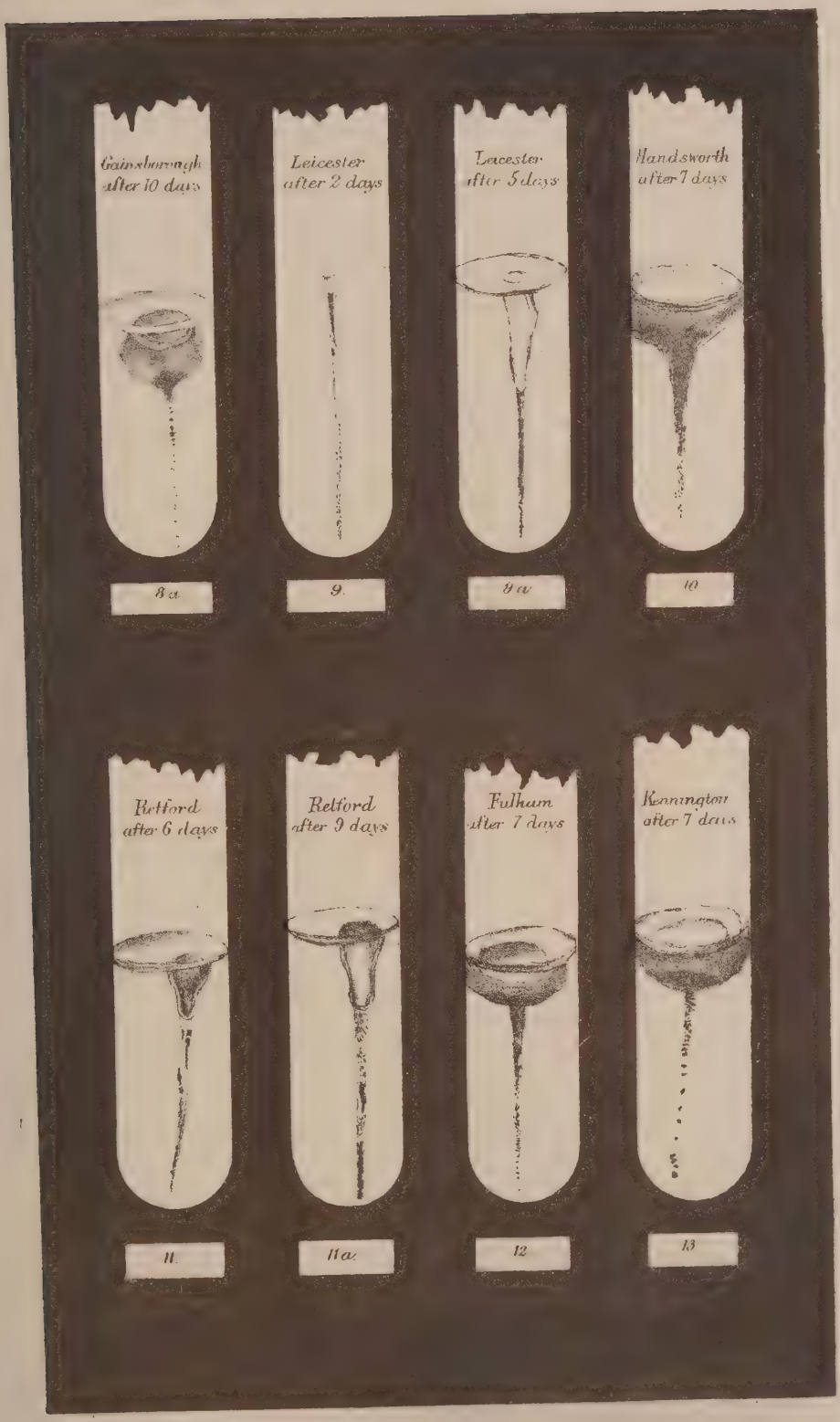
BACTERIOLOGY OF CHOLERA.

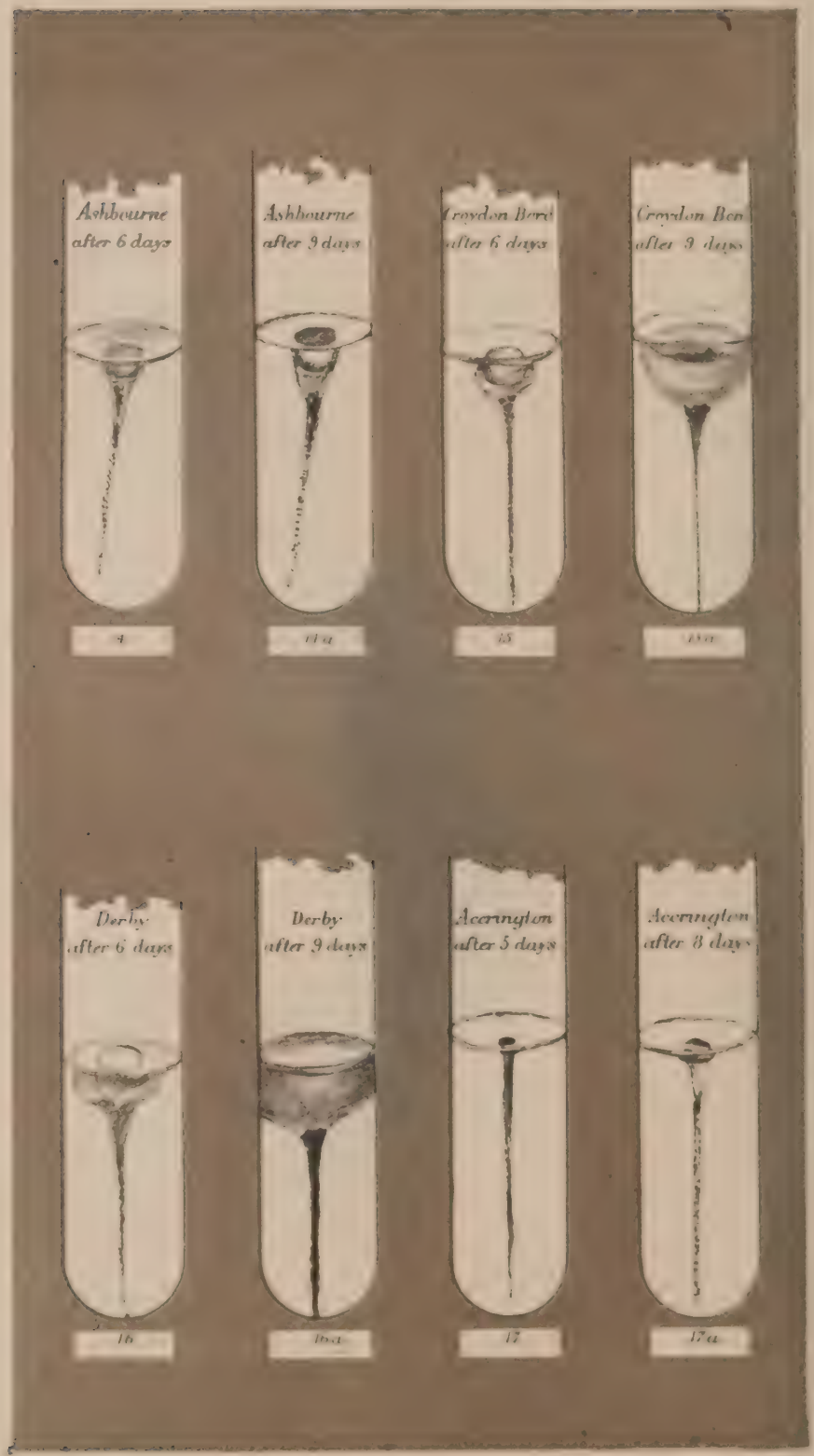
PLATE VIII.

NOTE.—The drawings in this, as in other plates, VII. to XII. inclusive, represent *stab-cultures* in gelatine of the comma-bacilli obtained from different samples of cholera material examined by me in 1893. These drawings enable comparison to be made, as regards rapidity of growth and liquefaction of the gelatine, between comma-bacilli from the different sources. The gelatine medium used was in every instance of precisely the same composition, and in all the subcultures depicted the contained comma-bacilli were an equal number of removes from the raw material whence they were derived. The gelatine medium was inoculated in each instance by a single stab, and all the subcultures were incubated at 20° C.—E.K.]

Fig. 8 (A). Morton (Gainsborough R.); No. X. in the text of this report
Figs. 9 and 9 (A). Leicester; No. XII. " "
Fig. 10. Handsworth (Yorks); No. XIII. " "
Figs. 11 and 11 (A). Retford; No. XIV. " "
Fig. 12. Fulham; No. XV. " "
Fig. 13. Kennington (Lambeth); No. XVII. " "

Handsworth and Fulham afford the most rapidly liquefying comma-bacilli of this series.


Gainsborough after 10 days
8 a
Leicester after 2 days
9
Leicester after 5 days
9 a
Handsworth after 7 days
10
Retford after 6 days
11
Retford after 9 days
11 a
Fulham after 7 days
12
Kennington after 7 days
13


Ashbourne after 6 days
Ashbourne after 9 days
Croydon Bord after 6 days
Croydon Bor after 9 days
4
11a
15
15a
Derby after 6 days
Derby after 9 days
Accrington after 5 days
Accrington after 8 days
16
16a
17
17a

BACTERIOLOGY OF CHOLERA.

PLATE IX.

[Note.—The drawings in this, as in other plates, VII. to XII. inclusive, represent *stab-cultures* in gelatine of the comma-bacilli obtained from different samples of cholera material examined by me in 1893. These drawings enable comparison to be made, as regards rapidity of growth and liquefaction of the gelatine, between comma-bacilli from the different sources. The gelatine medium used was in every instance of precisely the same composition, and in all the subcultures depicted the contained comma-bacilli were an equal number of removes from the raw material whence they were derived. The gelatine medium was inoculated in each instance by a single stab, and all the subcultures were incubated at 20° C.—E.K.]

Figs. 14 and 14 (A), Ashbourne; No. XVIII. in the text of this report.
Figs. 15 and 15 (A), Croydon; No. XXII. „ „ „
Figs. 16 and 16 (A), Derby; No. XXIV. „ „ „
Figs. 17 and 17 (A), Accrington; No. XXVII. „ „ „

Croydon and Derby afford instances of rapidly liquefying comma-bacilli, and in this sense are in contrast with Accrington and Ashbourne.

BACTERIOLOGY OF CHOLERA.

PLATE X.

[Note.—The drawings in this, as in other plates, VII. to XII. inclusive, represent *stab-cultures* in gelatine of the comma-bacilli obtained from different samples of cholera material examined by me in 1893. These drawings enable comparison to be made, as regards rapidity of growth and liquefaction of the gelatine, between comma-bacilli from the different sources. The gelatine medium used was in every instance of precisely the same composition, and in all the subcultures depicted the contained comma-bacilli were an equal number of removes from the raw material whence they were derived. The gelatine medium was inoculated in each instance by a single stab, and all the subcultures were incubated at 20° C.—E.K.]

Figs. 18 and 18 (A), Ilkeston; No. XXX. in the text of this report.

Figs. 19 and 19 (A), Appleton-le-Street (1) (Malton Rural); No. XXXIII. in the text of this report.

Fig. 20, Great Yarmouth (1); No. XXXVI. in the text of this report.

Figs. 21 and 21 (A), Tividale (Rowley Regis); No. XXXVIII. in the text of this report.

Fig. 22, Southwark (St. George the Martyr); No. XXXIX. in the text of this report.

Southwark is an example of comma-bacilli that are practically non-liquefying: and Ilkeston and Tividale (Rowley Regis) represent comma-bacilli that liquefy the gelatine only slowly.

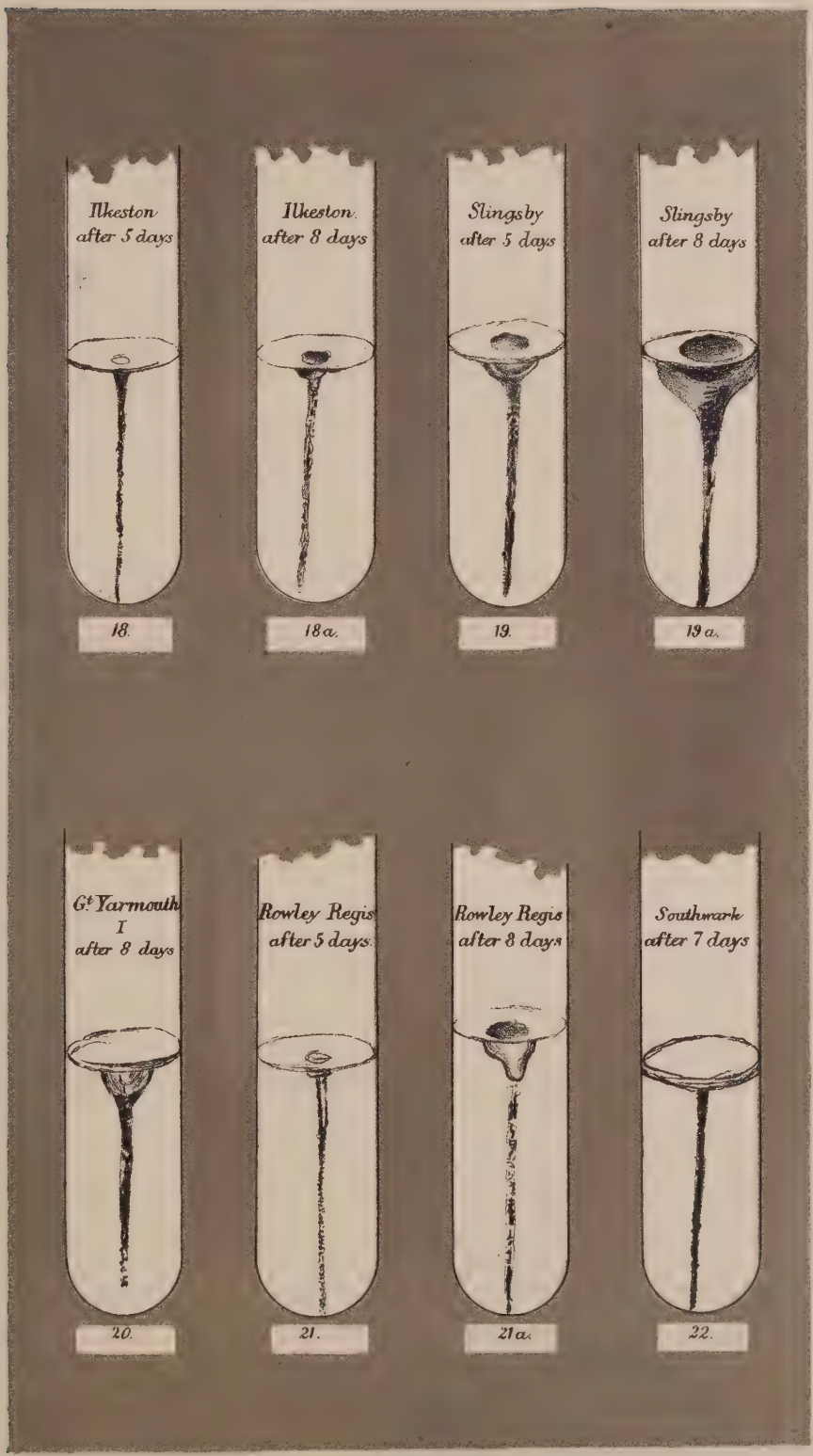
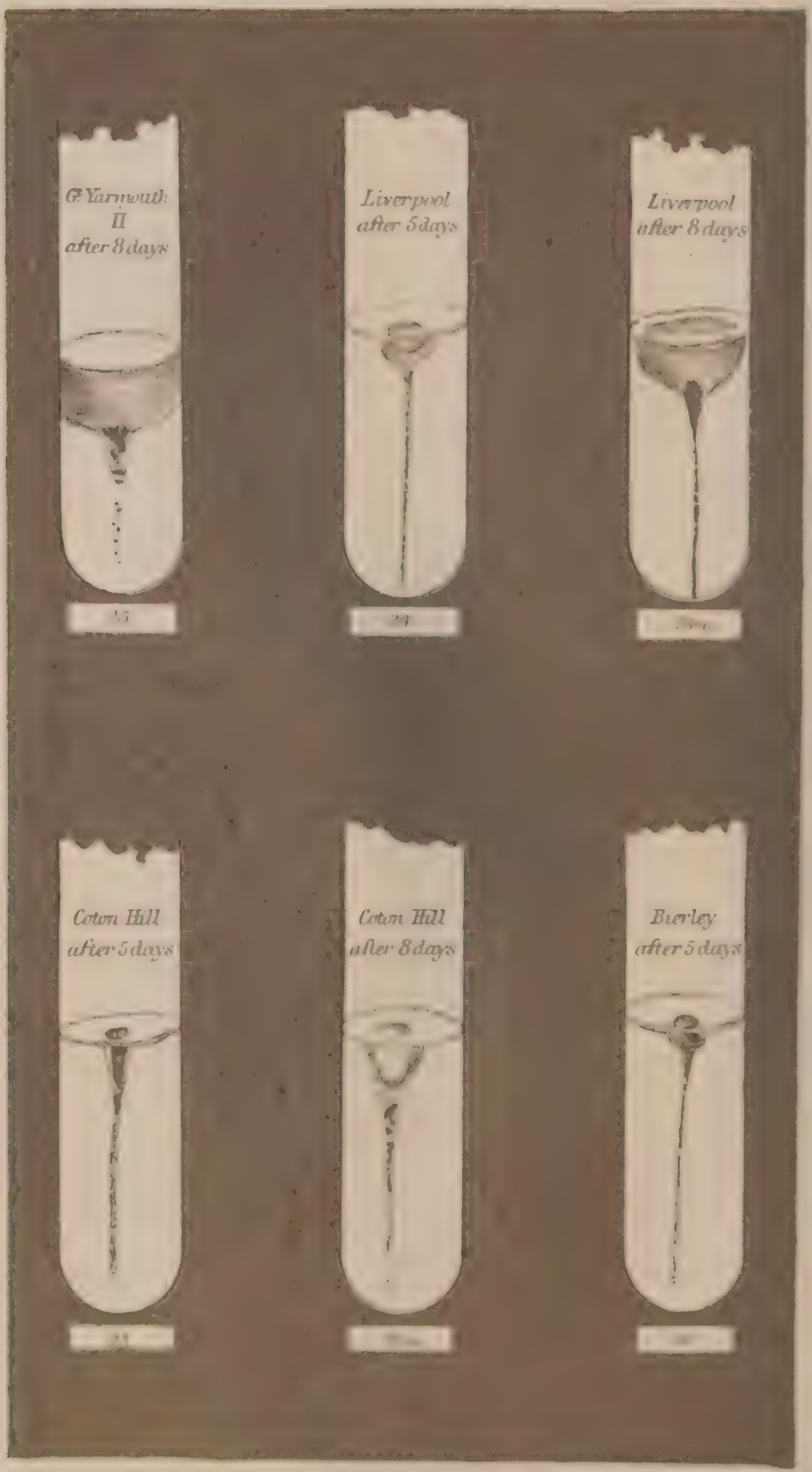

Ilkeston
after 5 days
18.
Ilkeston
after 8 days
18 a.
Slingsby
after 5 days
19.
Slingsby
after 8 days
19 a.
Gt Yarmouth
I
after 8 days
20.
Rowley Regis
after 5 days
21.
Rowley Regis
after 8 days
21 a.
Southwark
after 7 days
22.

Plate XI.


G. Yarmouth
II
after 8 days
Liverpool
after 5 days
Liverpool
after 8 days
Coton Hill
after 5 days
Coton Hill
after 8 days
Burley
after 5 days

BACTERIOLOGY OF CHOLERA.

PLATE XI.

[NOTE.—The drawings in this, as in other plates, VII. to XII. inclusive, represent *stab-cultures* in gelatine of the comma-bacilli obtained from different samples of cholera material examined by me in 1893. These drawings enable comparison to be made, as regards rapidity of growth and liquefaction of the gelatine, between comma bacilli from the different sources. The gelatine medium used was in every instance of precisely the same composition, and in all the subcultures depicted the contained comma-bacilli were an equal number of removes from the raw material whence they were derived. The gelatine medium was inoculated in each instance by a single stab, and all the subcultures were incubated at 20° C.—E.K.]

Fig. 23, Great Yarmouth (2); No. XL. in the text of this report.

Figs. 24 and 24 (A), Liverpool; No. XLI. ,, ,,

Figs. 25 and 25 (A), Coton Hill (Stafford Rural); No. XLIII. in the text of this report.

Fig. 26, North Bierley (2); No. XLV. (A) in the text of this report.

Great Yarmouth (2) affords an instance of comma-bacilli rapidly liquefying gelatine; Coton Hill of comma-bacilli accomplishing this more slowly.

BACTERIOLOGY OF CHOLERA.

PLATE XII.

NOTE.—The drawings in this, as in other plates, VII. to XII. inclusive, represent *stab-cultures* in gelatine of the comma-bacilli obtained from different samples of cholera material examined by me in 1893. These drawings enable comparison to be made, as regards rapidity of growth and liquefaction of the gelatine, between comma-bacilli from the different sources. The gelatine medium used was in every instance of precisely the same composition, and in all the subcultures depicted the contained comma-bacilli were an equal number of removes from the raw material whence they were derived. The gelatine medium was inoculated in each instance by a single stab, and all the subcultures were incubated at 20° C.—E.K.

Fig. 26 (A), North Bierley (2). No. XLV. (A) in the text of this report.

Figs. 27 and 27 (A), Balby (Doncaster Rural); No. LI. in the text of this report.

Fig. 28, Rawmarsh; No. LII. in the text of this report.

Fig. 29, Bingley (Township); No. LIV. in the text of this report.

Fig. 30, Keighley; No. LV. in the text of this report.

Bingley and Keighley afford instances of comma-bacilli liquefying the gelatine with great rapidity.

Plate XII.

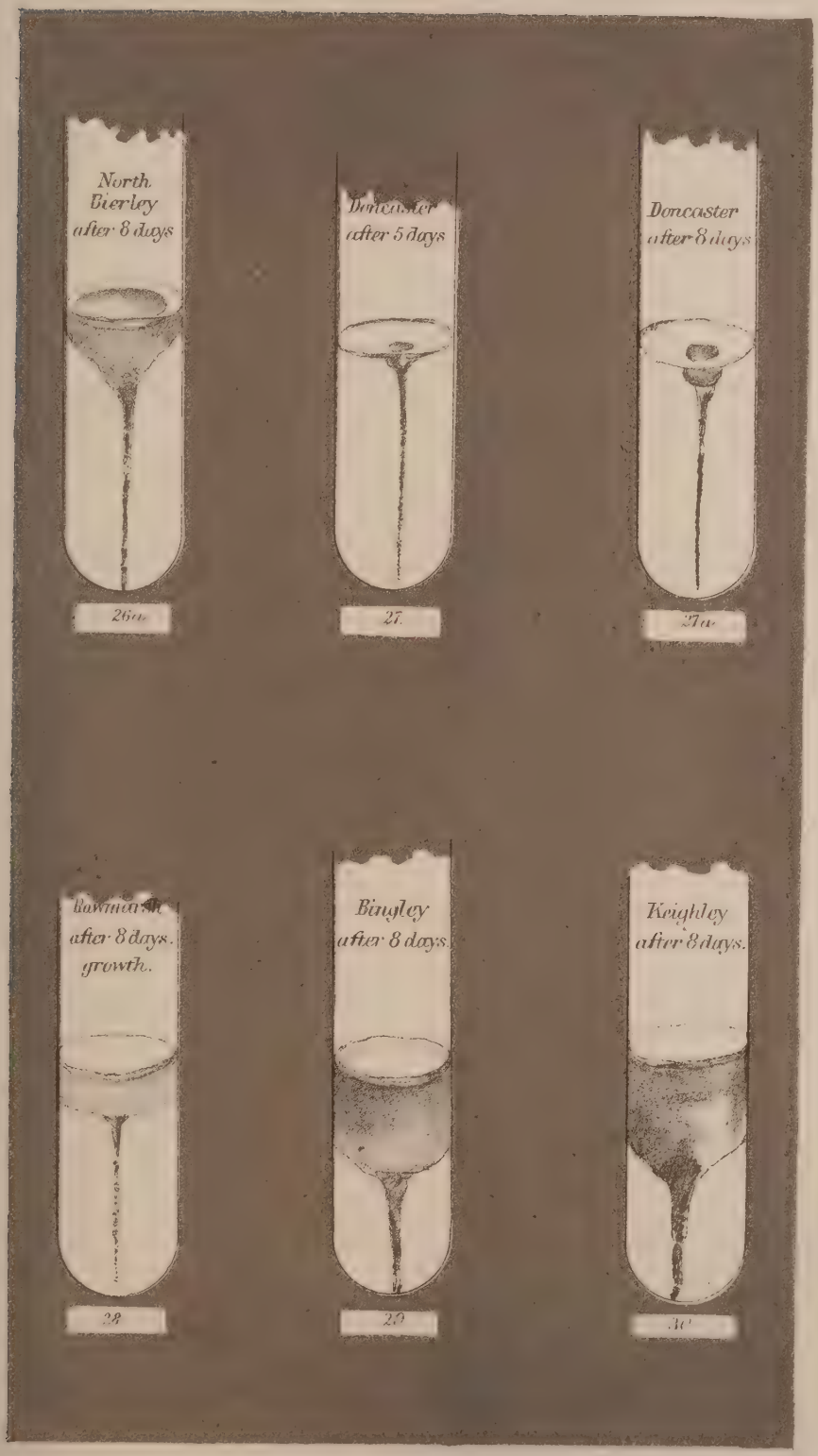
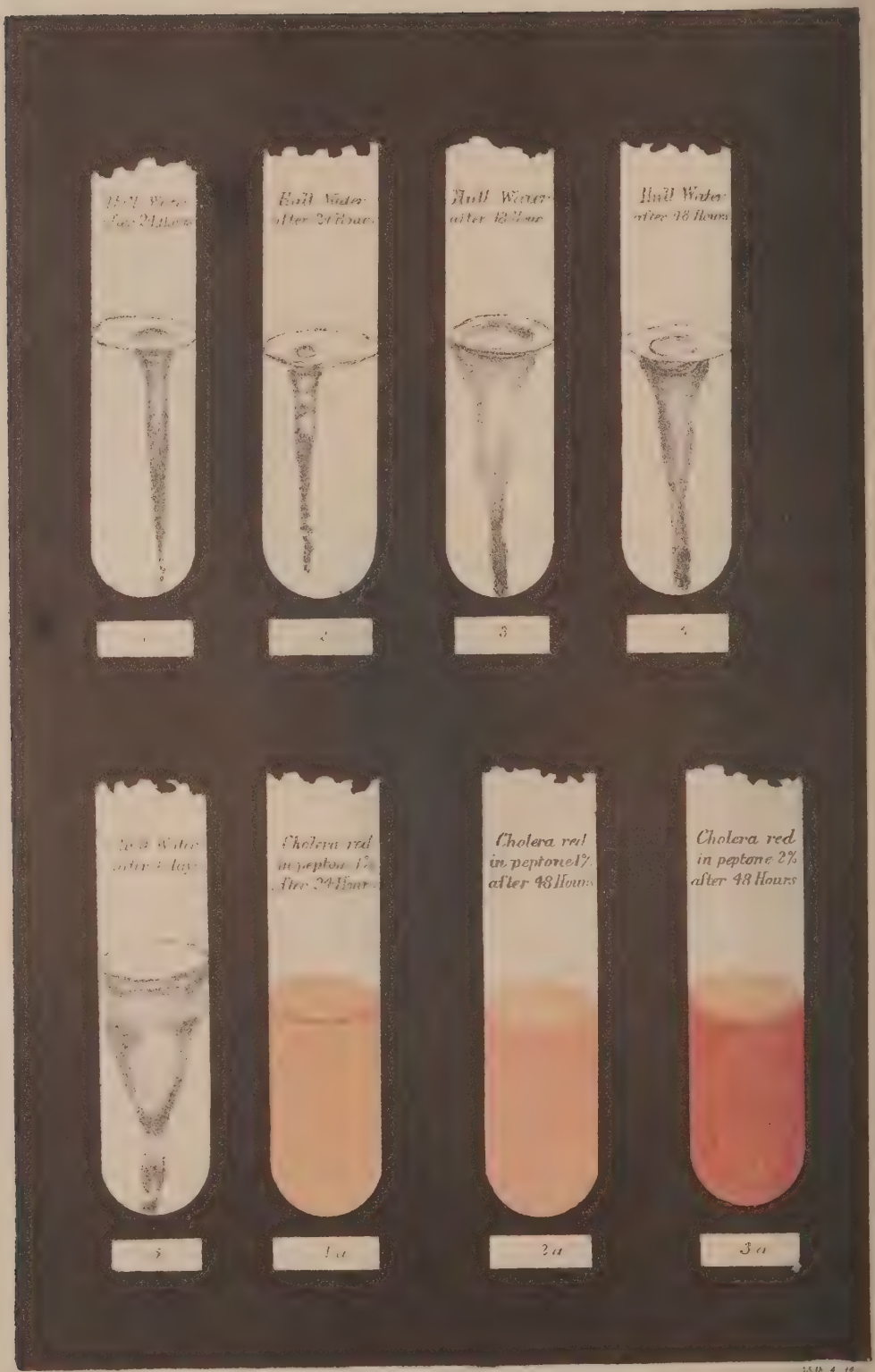

North Bierley after 8 days
26a
Doncaster after 5 days
27
Doncaster after 8 days
27a
Bowling &c after 8 days growth.
28
Bingley after 8 days
29
Keighley after 8 days.
30

Plate XIII.


Hull Water after 24 Hours
Hull Water after 24 Hour
Hull Water after 48 Hour
Hull Water after 48 Hours
Cholera red in peptone 1% after 24 Hour
Cholera red in peptone1% after 48 Hours
Cholera red in peptone 2% after 48 Hours
1
2
3
4
5
1 a
2 a
3 a

BACTERIOLOGY OF CHOLERA.

PLATE XIII.

Stab-cultures in gelatine of comma-bacilli from the water of Sutton Dyke, Hull.

Figs. 1 and 2, after incubation at 20° C. for 24 hours.
Figs. 3 and 4, ,, ,, 48 hours.
Fig. 5, ,, ,, 4 days.

Cholera-red reaction produced, after incubation at 37° C., in subcultures in peptone salt solution of comma-bacilli, by addition of pure sulphuric acid.

Fig. 1 (A). Acid added, to subculture in a solution containing 1 per cent. peptone, after incubation for 24 hours.

Fig. 2 (A). Acid added, to subculture in a solution containing 1 per cent. peptone, after incubation for 48 hours.

Fig. 3 (A). Acid added, to subculture in a solution containing 2 per cent. peptone, after incubation for 48 hours.

BACTERIOLOGY OF CHOLERA.

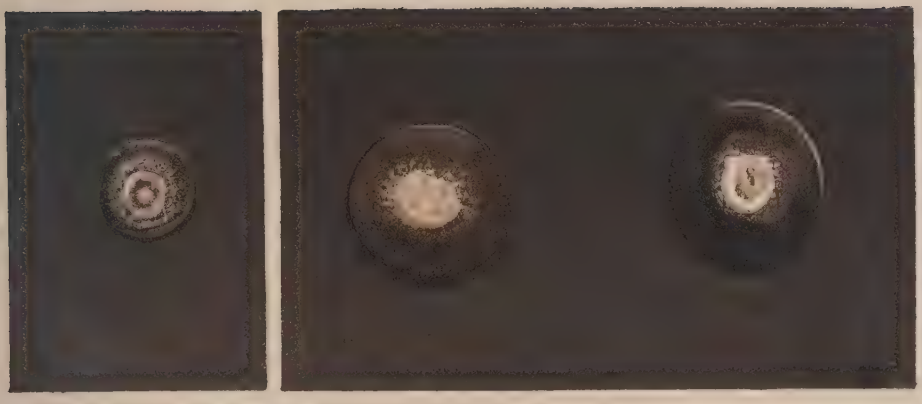
PLATE XIV.

Colonies in *gelatine-plate culture* of the comma-bacilli derived from different cholera cases; after incubation at 20° C.

The colonies are represented twice their natural size.

Figs. 1, 2, and 3. Grimsby (2); No. III. in the text of this report.
Figs. 4 and 5, Westminster; No. VI. in the text of this report.
Fig. 6. Ashbourne; No. XVII. in the text of this report.

Plate XIV.



1. *Grimsby II. 6 days.*

2

3

Grimsby II 8 days.

Westminster 4 days.

Ashbourne 5 days.

7

8

Fulham 6 days

9

Accrington 6 days

10

Southwark 3 days

BACTERIOLOGY OF CHOLERA.

PLATE XV.

Colonies in *gelatine-plate culture* of comma-bacilli derived from different cholera cases; after incubation at 20° C.

[The colonies are represented twice their natural size.]

Figs. 7 and 8, Fulham; No. XV. in the text of this report.
Fig. 9, Accrington; No. XXVII. in the text of this report.
Fig. 10, Southwark (St. George the Martyr); No. XXXIX. in the text of this report.

BACTERIOLOGY OF CHOLERA.

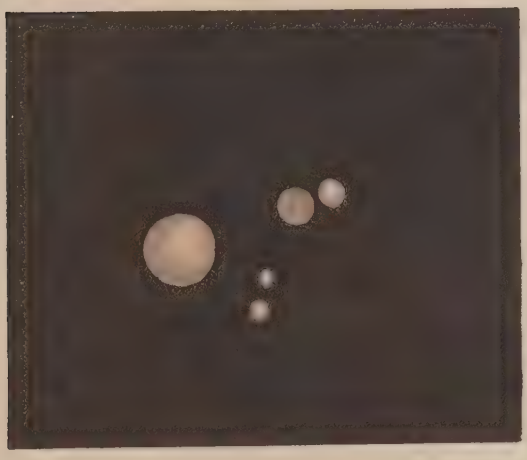
PLATE XVI.

Colonies on *the surface of agar plates* of comma-bacilli derived from different cholera cases; after incubation at 37° C.

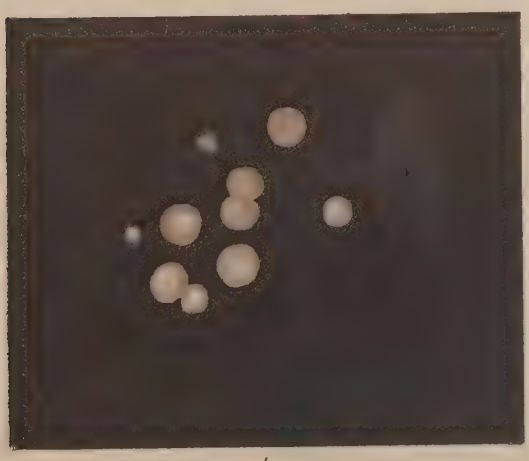
[The colonies are represented twice their natural size.]

Fig. 1, Grimsby (2); No. IV. in the text of this report.
Fig. 2, Westminster; No. VI. ,, ,,
Fig. 3, Southwark (St. George the Martyr); No. XXXIX in the text of this report.

Southwark Agar 24 Hours



2.
Westminster, 24 Hours Agar



1.
Grimsby II. 24 Hours Agar

1 2

Hull Water 24 Hours

3

Hull Water 48 Hours

4

Comma bacillus Greenwich water 2 days

BACTERIOLOGY OF CHOLERA.

PLATE XVII.

Colonies *in gelatine plate culture* of comma-bacilli from the Sutton Dyke Water, Hull, and from the water of the Greenwich Workhouse well; incubated at 20° C.

Figs. 1, 2, and 3, Sutton Dyke Water, Hull; pages 192–93 of this report.
Fig. 4, Greenwich Workhouse well; page 235 ,,

BACTERIOLOGY OF CHOLERA.

PLATE XVIII.

Figs. 5 and 6. Colonies of proteus vulgaris, derived from the water of the Greenwich Workhouse well, liquefying the gelatine medium in which they are growing; after incubation at 20° C.

Fig. 7. Colonies of a proteus-like organism, derived from the intestinal contents of one of the Greenwich Workhouse diarrhœa cases, liquefying the gelatine in which they are growing; after incubation at 20° C.

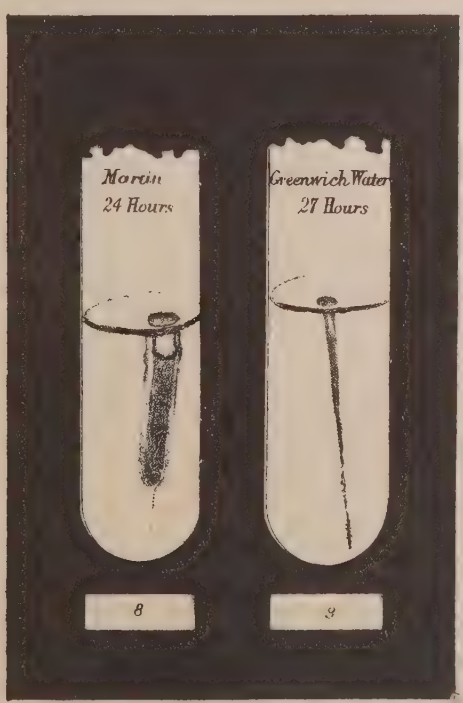
Fig. 8. A *stab-culture* in gelatine of the proteus-like organism from a Greenwich Workhouse diarrhœa case; after incubation at 20° C.

Fig. 9. A *stab-culture* in gelatine of proteus vulgaris from the water of the Greenwich Workhouse well; after incubation at 20° C.

5.
Greenwich Water after 36 Hours.

6.
Greenwich Water after 48 Hours.

7
Martin Greenwich 36 Hours.



APPENDIX C.

REPORT on an OUTBREAK of ILLNESS characterized by DIARRHŒA, VOMITING, and CRAMPS, which occurred at the GREENWICH UNION WORKHOUSE, MAZE HILL, in October 1893; by Dr. H. TIMBRELL BULSTRODE.

On Thursday, October 12th, 1893, a communication was received from Mr. Braxton Hicks, Coroner for the South-Western District of London, informing the Board that the body of a woman, named Harriett C., was awaiting inquest at the Lambeth Mortuary. It appeared that C. had died while out on leave from Greenwich Workhouse, after a violent attack of diarrhœa and vomiting.

Mr. Braxton Hicks also mentioned, as a matter incidentally reported to him, that there had been numerous cases of a similar nature at Greenwich Workhouse, and that three deaths had already resulted. Upon inquiry the same day at Greenwich Workhouse, the Coroner's statement respecting a diarrhœal outbreak there was fully confirmed.

With regard to the history of Harriett C., it appeared that she left the Workhouse on the morning of Tuesday, October 10th (a liberty day for the inmates), with the object of paying a visit to her niece at Royal Street, Lambeth.

Mrs. C. took the tramcar from Greenwich to Lambeth, but on the way vomited freely. At the end of the journey she was met by her niece, who had some difficulty in getting her aunt to Royal Street, owing to the vomiting which still continued. The patient, after her arrival at Royal Street, continued to suffer from vomiting, and from diarrhœa also. She died in collapse at 8.45 a.m. October 11th. Mrs. C. had, it appeared, been troubled with some diarrhœa prior to her excursion on October 10th, but it was not considered, either by her or by the nurse, of sufficient moment to prevent her paying a visit to her niece. She was, it seems, very liable to passing attacks of diarrhœa.

The post-mortem examination of Harriett C. was made by the officers of the London County Council, and I was instructed to watch the autopsy on behalf of the Board. As the examination revealed no sufficient evidence as to what was the cause of death, a portion of the ileum, together with its contents, was excised and forwarded to Dr. Klein for bacteriological examination, while the stomach with parts of other viscera were reserved pending the Coroner's instructions.

Dr. Klein's interim report, dated October 14th, upon the results of microscopical and cultural examination of the contents of the ileum, was as follows:—"The microscopical examination of the contents of the "ileum of Harriett C., who died at Lambeth, showed the presence, "amongst crowds of various bacteria, of some forms which were "undoubted commas, and revealed also even free flagella of commas; "but the cultivations yielded negative results."

Upon receipt of the above information, I was directed by the Board to make detailed investigation of the outbreak of diarrhœal disease at the Greenwich Workhouse, with which the case of the woman C. had been obviously related.

Before proceeding with an account of the outbreak at the Greenwich Workhouse it will facilitate the narrative that is to follow if a general description of the Workhouse and Infirmary be here given.

GREENWICH UNION WORKHOUSE AND INFIRMARY.

Site.—The site upon which these two buildings stand is situated at Maze Hill, Greenwich, in latitude 51° 29′ 6″ N. and longitude 0° 0′ 39″ E.

Its area is about 8 acres in extent, and it has a gentle slope from south-east to north-west. At its lowest part the site is about 11 feet above Ordnance Datum. On the east and south the site is surrounded by houses, from the curtilages of which it is separated by a high brick wall. On the west and north it is cut off by means of a similar wall from the Woolwich Road and the Vanbrugh Hill. A little to the south-east, and at a higher level than the site, is the Royal Hospital Cemetery, where interments take place at distant intervals.

Geology.—It will be seen by reference to the maps of the Geological Survey of this district that a "fault," or dislocation of strata, running from N.E. to S.W., is depicted as intersecting the Workhouse site. The relations thus indicated of the Workhouse and the "fault" raised question whether one or other of two wells which supplied the inmates of these institutions with water passed into or through the "fault;" in a way to draw water from the River Thames, across which the "fault" extends, or from the Deptford Creek which also apparently passes over it. And some evidence appeared in support of this view from a record of the strata which were stated to have been passed through in making the Greenwich Workhouse well.* This record gives the thickness of Thanet Sand at this point as but 11 feet, whereas the average thickness of this bed hereabouts would seem to be much in excess of this. My attention was drawn to this latter point by the late Mr. W. Topley, F.R.S., of the Geological Survey, who kindly afforded me some valuable assistance. In my endeavour to localise this "fault," I was also much aided by Mr. T. V. Holmes, F.G.S., late of the Geological Survey and now resident at Greenwich, who, after comparing several well borings and sections in the neighbourhood, came to the conclusion that the course of the "fault," as represented on the geological map, was too far to the south; that really it passed not through, but just to the north of the Workhouse site. It appeared, too, that when the second well, that for the Infirmary, was sunk, Chalk was struck after penetrating 30 feet of gravel; a fact which seemed to indicate that this well was to the south, or on the upthrow side, of the "fault," since none of the lower Tertiaries, such as Blackheath and Woolwich beds and Thanet Sands, were found here.

Reviewing all the evidence obtainable, it seems probably that both Workhouse and Infirmary are situated on the river gravel overlying Chalk, and to the south of, instead of on, the "fault."

The Workhouse consists of a main building, and of several accessory buildings. The main building occupies a large area in the northern section of the site, and extends east and west almost to the boundaries. Immediately south of it is another building known as the "Old Infirmary," which communicates with the main building by a covered passage. To the north and structurally distinct from the main building, are two blocks of wards, more recently erected than the others, known as the

* Geology of London (Whitaker), Vol. II. Greenwich Union Workhouse. Dr. J. Mitchell's MSS., Vol. IV.

	Thickness in Feet.	Depth in Feet.
Earth - - - -	5	5
Gravel - - - -	2	7
Blue clay - - - -	30	37
Coloured clay - - - -	6	43
Sand - - - - -	11	54
Chalk - - - - -	30	84

East and West Blocks. Between these two blocks, but cut off from them by walls and airing courts, are the male and female "receiving rooms" and other offices of the institution; and on the eastern confines of the main building are the casual wards and the stone-breaking sheds, both of them separate from the Workhouse and entered from a separate gateway. Wards and blocks to the west of the centre of the institution are, in the main, occupied by males, those to the east of the centre by females.

The Infirmary is situated to the south of, and at a higher level than, the Workhouse proper; the site upon which it stands being, however, practically continuous with that of the Workhouse. The Infirmary buildings are arranged on the pavilion principle; there being four pavilions (two male and two female), with an administrative block. The pavilions and the administrative block communicate one with another by means of closed corridors. Access to the Infirmary is obtained by an entrance separate from that to the Workhouse.

Inter-relations of the Workhouse and the Infirmary.—Though these establishments are structurally and administratively separate institutions, and though (as will presently be seen) they have different water-supplies, they possess certain conditions in common. They are drained to a common sewer, and the chapel (as also the mortuary) is common to both insitutions. Moreover, there is not infrequent communication between them by means of their officers, as for instance the medical attendants and the chaplain, and in other ways. Thus, cases of serious illness which occur in the Workhouse are, if necessary, removed for better observation to the Infirmary, and all cases of illness in the Workhouse are visited frequently by the medical officers of the Infirmary. In addition, on every Tuesday, between 2 and 4 p.m., patients in the Infirmary are visited by their friends in the Workhouse, while on every Sunday Infirmary patients are visited by their relatives and friends from outside.

Communication between the Workhouse and the outer world is frequent. The first and second Tuesday in each month are "liberty days," the first Tuesday for the males and the second Tuesday for the females. Husband and wife are allowed out together on the "male" days. On every Monday there are visitors from the outside to the Workhouse. There are, too, the daily visits of the tradesmen, the journeyings to and fro of the Workhouse messengers, the arrivals in the receiving room, and some irregular visiting of friends and relations owing to special circumstances. On Sundays and Wednesdays those inmates of either the Workhouse or the Infirmary, who are so disposed, have opportunity of attending service in the chapel.

As regards drainage arrangements, there is not need for the purposes of this report to enter into a detailed description of the drains, either of the Workhouse or Infirmary. The main part of the former building was erected about 1840, with additions and alterations in the years 1843, 1876, and 1886; while the latter was completed in 1876, and additional blocks were built in 1889. Both Workhouse and Infirmary are drained to the public sewer in the Woolwich Road; in part separately, in part by a drain or drains common to both institutions. The drainage of the several parts of the total establishment varies according to the principles and practices in vogue at the time of their erection; and speaking generally the more recently erected Infirmary is far better off in the matter of drainage than the Workhouse. The main drains of the Workhouse are quite obsolete, consisting as they do of old brick barrels which pass under several of the inhabited portions of the building. The soil pipes in the older portions of the Workhouse are

either not ventilated at all or are ventilated quite inadequately; while occasionally they pass into old mason's traps. In some instances the closets are practically inside the wards, *i.e.*, are not cut off from them by any system of cross ventilation; and the soil pipes are inside the buildings. The closet pans are often inadequately provided with flushing apparatus. Baths and lavatory wastes are, in the older portions, neither properly trapped nor disconnected, and rain-water pipes are, in many instances, not cut off from the drains as they should be. In some cases an attempt has been made to ventilate the soil pipe by means of combining it with a rain pipe, a condition of affairs which tends to diminish the ventilating value of the soil pipe ventilator, at a time when there is the greatest need for relieving pressure in the drains. In almost all these respects the Infirmary contrasts favourably with the Workhouse.

History of the Outbreak.

At the date of the outbreak the Workhouse contained 586 males, 567 females, and 26 infants of both sexes. Similarly the Infirmary contained 227 males, and 153 females, making a total for the combined institutions of 1,559.

The subjoined table will assist the reader in following the account now to be given of the inception and progress of the outbreak.

Date.	Workhouse.			Infirmary.			Cases imported from outside.	Total Cases.
	Average Number of Inmates, 1,155.	Total Number of Wards, 104.	Number of Nurses, 12.	Number of Inmates, 440.	Number of Wards, 32.	Number of Nurses, 40.		
	Number of Inmates attacked.	Number of Wards freely invaded.	Nurses attacked.	Number of Inmates attacked.	Number of Wards freely invaded.	Number of Nurses attacked.		
Oct. 1	1	1	—	—	—	—	—	1
„ 5	0	0	—	—	—	—	—	0
„ 6	2	2	—	—	—	—	—	2
„ 7	13	7	—	—	—	—	—	13
„ 8	15	12	—	—	—	—	—	15
„ 9	63	23	—	—	—	—	—	63
„ 10	31	3	—	—	—	—	—	31
„ 11	32	4	—	1	1	—	—	33
„ 12	18	3	—	1	1	—	1	20
„ 13	16	2	—	—	—	—	—	16
„ 14	16	2	—	—	—	—	2	18
„ 15	12	3	1	—	—	—	1	14
„ 16	6	2	—	—	—	1	—	7
„ 17	7	2	—	—	—	—	—	7
„ 18	1	1	—	—	—	—	—	1
„ 19	0	0	—	—	—	—	—	0
„ 20	2	0	—	—	—	—	—	2
„ 21	0	0	—	—	—	—	—	0
„ 22	5	0	2	—	—	—	—	5
„ 23	0	0	—	—	—	—	—	0
„ 24	0	0	1	—	—	—	—	1
Totals	238	67	4	2	2	1	4	249

The first case coming to the knowledge of the medical staff occurred on *October 4th*. The patient, a male, aged 74 years, had been resident in the Workhouse for eight years. He had been out on leave on October 3rd, which was a "liberty day" for the male inmates. On that occasion he visited his sister, who lived at Greenwich; but, so far as the evidence I was able to obtain went, he did not then come in contact with anyone affected with the symptoms characteristic of the outbreak, nor did he consume anything which might have been likely to cause his attack. He may, of course, have been developing the illness before he went out.

The next two cases that came to the knowledge of the officials occurred on *October* 6*th* on the female side of the Workhouse; both were able-bodied inmates.

On October 7*th* there were 12 females, distributed in seven different wards, of the Workhouse attacked. These wards were situated in all parts of the female side, except that known as the "East Block," a detached building containing 119 females. There were on this day no recognised attacks amongst the males.

On October 8*th* several seizures occurred on both the male and the female sides of the Workhouse. There were attacked four males in as many different wards, including one case in the "West Block," containing 119 infirm males; and 11 females in 10 wards. So far, however, no case had occurred in the "East Block."

On October 9*th* the heaviest incidence of the disease took place, there being in all no less than 63 attacks, all in the Workhouse, of whom 29 were males and 34 females. Both the East and West Blocks suffered severely on this date, and there were altogether 13 male and 21 female wards involved.

On October 10*th* 10 males were attacked, eight separate wards on this side of the Workhouse being involved; while on the female side 21 inmates, distributed in 12 wards, were attacked.

On October 11*th* eight males, inhabiting six different wards of the Workhouse were attacked; and one case (on the male side) in the Infirmary. On the female side of the Workhouse 24 inmates, inhabiting 17 wards, were attacked.

On October 12*th* three males, in three separate wards, were attacked; and 15 females in 14 wards. All of these in the Workhouse. Also there was one female attacked in the Infirmary; and one female case was imported from outside.

On October 13*th* seven males in the Workhouse were attacked in six wards; also nine females in nine wards.

On October 14*th* six males in six wards, and 10 females in seven wards, were attacked; all of them in the Workhouse. One female and one male were brought in ill from outside.

On October 15*th* was the last day on which any male inmates were attacked, there being then six attacks in four wards on this side of the Workhouse; while one case was imported. On the female side six inmates were attacked in the same number of wards. In addition to these cases, one of the nurses who was in attendance on the patients in the East Block, was attacked.

On October 16*th* six female cases occurred, distributed in five wards of the Workhouse. There was also attacked on this day one of the Infirmary nurses who was in charge of the patients removed there from the Workhouse.

On October 17*th* seven females were attacked in six wards of the Workhouse.

On October 18*th* there was one girl in the "nursery" of the Workhouse attacked.

On October 19*th* there were no attacks.

On October 20*th* two cases occurred among females in different wards of the Workhouse.

On October 21*st* there were no attacks.

On October 22*nd* there were among the female inmates four attacks in three wards of the Workhouse, and in addition to these, two of the nurses in attendance upon the patients in the West Block were attacked.

After this there were no attacks among the inmates, but on *October* 24*th* one of the nurses in charge of the patients of the East

Block of the Workhouse was attacked, and on October 27th she had a serious relapse.

Reviewing the outbreak as a whole, it will be seen that it extended over a period of twenty days, *i.e.*, from October 4th to 24th, and that it was almost wholly limited to the Workhouse.

The distribution of the 249 attacks will be seen at a glance at the following summary :—

238	inmates of Workhouse attacked.
2	„ Infirmary „
5	nurses.
4	cases from outside.
249	

The fatal attacks numbered 11.

The attacks were distributed over all parts of the Workhouse, though that occupied by the able-bodied males suffered hardly at all. The children's quarters, too, were almost completely exempt.

In a large number of wards there were cases day by day, and it was noticed that they frequently occurred in the adjoining beds.

Although the first case occurred in the Workhouse on October 4th, it was not until the 8th and 9th of the month that the West and East Blocks became respectively invaded. And the Infirmary was not implicated before the 11th.

Clinical and other Features of the Malady.

Symptoms.—In some persons and perhaps, as a rule, the attack commenced quite suddenly. In many cases the patients awoke from their sleep in the early morning with severe abdominal pain, rapidly followed by diarrhœa and vomiting. In a large number there were, in addition, severe cramps in the feet, legs, and abdomen, so that the patient became drawn up with pain. The patients were in the more severe cases much collapsed, and in some cases fainted in the latrines. Their features became contracted, their lips and extremities blue and cold, their voices feeble, and they suffered from intense thirst. As regards suppression of urine, I was unable to obtain any reliable information, more especially as in the worst cases the excretions were passed into the beds. No symptoms of uræmia were noticed in any of the cases.

It should be borne in mind that the above remarks apply to the severe cases, and that the severity of the attacks ranged from an illness resulting in death in 24 hours, to a mild and transient attack of diarrhœa; in fact, there were doubtless a large number of cases, especially among the males, which produced such slight inconvenience that they were not reported or classed at all. In a few cases patients were reported to have suffered from hæmatemesis, in others from melæna. In some instances vomiting was quite absent. At no time was anything like an eruption or rash observed on the bodies of patients suffering from the outbreak.

Premonitory Diarrhœa.—Early in the course of my examination of those who had been attacked, I was impressed with the fact that a considerable number had, for two or three days prior to the sudden onset of their acute symptoms, been affected with looseness of the bowels. I am unable to give the exact number of cases in which this symptom was present, but the occurrence was of sufficient frequency to justify its being taken into consideration in estimating the nature of the outbreak.

Nature of Motions and Vomit.—The motions in all the well-marked cases were of a liquid nature, some very much more so than others. The colour of the motions, according to the patients themselves, seems

to have varied very considerably, and to some extent this variation may have been due to the stage of the attack at which the patient took especial note of this. During the course of my inquiries I was, however, so impressed with the limited notions of colour which the Workhouse inmates possessed, that I am disinclined to attach much importance to their statements on the matter. The specimens seen by me varied in colour from light clay to a dark brown. Not one that I saw could be regarded as a typical rice water evacuation, though in some cases there was an approach to this condition. It is perhaps a point worthy of note that the peculiarly offensive odour which is said to be so frequently associated with the evacuations of persons ill from "food-poisoning" was absent, so far as I had opportunity of observing or ascertaining in these cases.

As regards the vomit, it too naturally varied much both in colour and consistency. It was described by the attendants as yellow, brown, black, frothy, green, white, dark, watery, &c. In the specimens that were shown me—many in number—the presence of bile was very conspicuous. In no instance did I see any typical "rice water" vomit. In the worst cases the vomiting was described as "constant;" in the milder cases it was infrequent, and in some there was nausea only.

Temperature and Pulse.—Unfortunately at the time of the outbreak owing to the junior assistant medical officer having recently left the service, the medical staff at the Workhouse and Infirmary comprised two medical men only. They had to attend, not only to the patients transferred to the Infirmary, but also to the numerous cases which day by day arose in the Workhouse. Under these circumstances the time, not only of the medical officers but also of the whole staff, was fully employed in meeting difficulties of administration, which consisted, primarily, in arranging for the isolation of those attacked, and for the disinfection of infected articles. Little leisure was found for detailed record of clinical observations.

Relapses.—Out of the total 249 cases which occurred, there were 13 which, within a week, suffered from a relapse of their symptoms. In some cases the relapse was of a more severe character than the primary attack, and gave rise to far more prostration. It is of course impossible to say, definitely, whether these secondary manifestations, which occurred in 5·2 per cent. of the cases attacked, are to be regarded as relapses or as re-infections; but looking at the short interval which intervened between the primary and secondary manifestations it would seem on the whole more reasonable to regard the recurrences of symptoms as relapses. It may be said then that there was a distinct tendency towards relapse in the disease.

Complications and Sequelæ.—Unless the relapses referred to above are to be considered in the light of complications or sequelæ, the disease under consideration must be regarded as entirely free from them. It is true that some of the patients died many days after they were attacked; but in these there were no signs of any implication of other viscera, and death was apparently caused by the inability of the patients, owing to their advanced age, to rally from the state of collapse produced by the exhaustive character of their illness.

Sex and Age in relation to the Disease.—As to *sex*, it will be seen, on referring to Addendum No. 4, that of the 238 attacks there recorded as having occurred amongst the Workhouse inmates, 164 were females and 74 males. This great excess of incidence upon the females cannot, as will be apparent from the Addendum referred to, be accounted for by any excess of females in the institution. Also, it has been seen that the females were day after day attacked in greater

numbers than the males, and furthermore that the females continued to be attacked for several days after the outbreak had ceased on the male side of the Workhouse.

As to *age*, Addendum No. 4 also serves to show the incidence of the disease on certain age groups. From this it will be seen that, having regard to the number of inmates at each age, there was a distinct predilection of the disease for the age groups "16–60" and "60 and over," more especially the latter; while in regard to the three age groups "9–16," "2–9," and the "infants," there was a very remarkable exemption from attack.

The children of both sexes under 16 years old are accommodated, as a general rule, in rooms, the "Nursery," in which they are kept quite distinct from other inmates of the Workhouse, and during play-hours they are restricted to play-grounds set apart exclusively for their use. There are, however, occasional exceptions to this arrangement, and a few of the quite young infants are sometimes kept in the adult wards for convenience of nursing, whether by their mothers or others of the inmates.

Amongst the children who were confined to the nursery rooms there was, throughout the whole outbreak, but one case bearing any resemblance to those occurring in the rest of the institution. This was that of a girl, aged 14, who, on 18th October, was attacked with violent vomiting and diarrhœa. But whilst among the few infants in the general wards of the Workhouse no typical attacks occurred; it was noticed that several of them, during the period of the outbreak, were attacked with smart diarrhœa.

Case Mortality.—There were in all, including the case of Harriett C—— who died at Lambeth, and that of William A., the nature of whose attack may be thought doubtful, 11 deaths attributable to the outbreak under consideration. Of the 11, six were females and five males, numbers which give a considerably higher case mortality amongst the males than females. The total number of deaths in each instance is, however, too small to base any reliable deductions upon.

The death-rate of all those attacked amounted to 4·4 per cent.

The ages at death ranged from 64 to 92, the majority of fatal cases being over 70 years of age.

The length of the illness from onset to death varied from 24 hours to as much as 11 days. The following is a list of the fatal attacks:—

Fatal Cases.

Name.	Age.	Date of Attack.	Date of Death.	Remarks.
Mary A.	77	Oct. 9th	Oct. 10th	
Harriett C.	71	„ 9th	„ 11th	Died in Lambeth, while on leave.
Mary W.	92	„ 10th	„ 11th	
William C.	68	„ 8th	„ 12th	
Jane C.	86	„ 12th	„ 13th	
Obadiah P.	74	„ 9th	„ 13th	
William A.	78	„ 9th	„ 14th	
Michael S. M.	64	„ 9th	„ 15th	
William N.	76	„ 9th	„ 15th	
Elsie T.	65	„ 11th	„ 27th	Vomiting and diarrhœa up to October 18th, never rallied.
Sarah H.	68	„ 9th	„ 30th	Unable to rally.

Pathology.—The post-mortem examinations of the fatal cases, were performed by Drs. Burney and Keats, the medical officer and the assistant medical officer of the institution; and to them I am indebted for the *précis* of their observations, which will be found annexed to this report. It will be seen that beyond a marked injection of the small intestines, more especially towards the lower end of the ileum, and an empty or contracted state of the bladder, nothing abnormal was generally observed.

Means of Distribution of the Disease.

It is first of all necessary to consider whether there has been at work any common medium by which the disease was conveyed to the persons attacked.

Drainage.

Inasmuch as the outbreak was almost wholly confined to the Workhouse, and, since the drainage of the Workhouse buildings was in large part obviously defective, whereas that of the Infirmary was much more modern in character, there must of course arise the question of possible relation of the disease to drainage.

To some extent, too, a theory of drainage causation of the outbreak would receive support from the consideration that the drainage of the Workhouse was, with the exception of a portion of the East Wing, well nigh distinct and separate from that of the Infirmary. But it so happened that the earliest manifestation of the outbreak among the females appeared in that section of the East Wing which has drainage in common with the Infirmary; and accordingly the almost complete escape throughout of the Infirmary hardly appears consistent with drain causation of the malady. Again, as regards the Workhouse, the several sections of it differ greatly in the matter of efficiency of drains; nevertheless sections of the Workhouse that were well drained suffered quite as much as sections that were ill drained. Moreover, as regards the male side of the house, the worst drained portion was almost exempt from attack. Further, there were no cases at all recognised as occurring in the "boys," who occupied a portion of the "old infirmary" at the Workhouse, where the drainage was particularly defective.

Upon the whole, therefore, it appeared that no satisfactory explanation of the outbreak was to be found in the conditions of drainage of one and another section of the establishment.

Water Supply.

On the other hand, there is no doubt that in many particulars the outbreak bears resemblance to some which have been regarded as due to the consumption of specifically polluted water or food.

Here were situated, practically side by side, two institutions having, broadly speaking, all things in common, with one exception; an exception which appeared at first to offer a sufficient explanation of the phenomena observed. Each institution was supplied by a separate well, and at the beginning of the outbreak—as also subsequently—the inmates of the Workhouse were attacked by symptoms which could apparently be explained on a thesis of polluted water, those of the Infirmary were free from all such manifestations. And furthermore, other facts, ascertained as matter of first instance, tended substantially to strengthen the case against the water.

The Workhouse Well is situated not far from the centre of the Workhouse site, and has erected over it a four-storied building some 53 feet in height, supporting an iron tank, having a capacity of 10,000 gallons, and furnished with an overflow pipe properly disconnected from the drains. The well consists of an excavation 5 feet in diameter,

carried to a depth of 10 feet 6 inches below the surface of the ground, and lined and floored with brick in cement. From the bottom of the excavation a bore hole, lined with an iron tube 12 inches in diameter, descends to a depth of 56 feet 6 inches. This iron tube projects upward for a few inches into the excavation above referred to, and is perforated with holes at its junction with the floor, to allow passage back into the tube of any water which may find its way into the excavation from the dripping of the pumps situated therein. The above statement as to the depth of the bore is based upon a sounding made by the engineer at a time when the suction pipe was out for repair; but the record in the Geological Memoir already referred to gives the total depth of the well as 84 feet. Several attempts were made at the time of my inquiry to ascertain, without disturbing all the pumping machinery, the exact depth of the well, but the projections at the joints of the suction tube prevented even a small piece of lead from passing down the bore below the first junction. On the last occasion when an opportunity of ascertaining the level of the water in the bore occurred, it was found, so I was informed, to be 11 feet 4 inches below the bottom of the well, *i.e.*, 21 feet 10 inches below the ground level. On examining the inside of the brickwork of the excavation from above, it appeared to be perfectly water-tight; but subsequently, not being satisfied with this inspection, I descended, in company with Mr. Keats, the senior assistant medical officer of the Infirmary, and made a careful examination of the sides. We found low down, close to the floor, distinct evidences of moisture, and it appeared that the moisture was due rather to fluid oozing inward through the brickwork than to the condensation of aqueous vapour upon its surface. On the floor of the excavation there were, here and there, small pools of water.

Within 14 feet of the workhouse well there existed an old brick barrel drain, and having regard to the general condition of the workhouse drainage little doubt could be entertained as to the likelihood of communication between this drain and the well. When too a specimen of this well-water, drawn by Dr. Downes from a tap in the Workhouse, was submitted to Dr. Klein for bacteriological examination, the existence of a comma bacillus, bearing strong microscopical resemblance to the bacillus of Asiatic cholera, was discovered in it; and there were also found in the same sample other micro-organisms not present in pure drinking water.*

Endeavours were made on two occasions to ascertain the existence of any communication between the drain and the well. For this purpose the drain was plugged, and large quantities of carbolic acid placed therein. The drain was allowed to remain blocked for some 48 hours, and the water from the excavation above the iron tube, as also from the well, was then frequently tested, but without detecting the existence of carbolic in it. Subsequently a similar experiment was attempted with paraffin oil, but the results were still negative. Again, an excavation was made just outside the wall of the pump-house, and a large quantity of cochineal having been placed therein, the water in the excavation and well was from time to time examined for the presence of this dye; none, however, could be detected. Nevertheless, it is quite possible, and in fact, looking at the result of Dr. Klein's analysis of the water, probable, that some connexion did exist between the well and the drainage of the workhouse, though the individual drain which was the subject of our experiment might not have been at fault.

From the well, the water is pumped up to the water-tower that has been referred to, and from this it is distributed to several cisterns in

* *See* Addendum No. 2.

various parts of the Workhouse buildings. In numerous cases the water-closets were supplied without the intervention of a separate cistern or service box; and as an instance of this condition of things may be mentioned the supply of some closets in one of the yards, which was discovered by Dr. Downes and myself in our preliminary inspection. In this case the closets were supplied direct from one of the main-service pipes as it descended from the water-tower, and in such a manner that ample opportunity under certain conditions would be afforded for the in-suction of closet air, if not of excrement, into the water main. Some 28 closets were subsequently discovered without any proper intercepting cisterns.

The Infirmary Well.—Concerning this well, which is of a much more modern date than that of the Workhouse, we have more accurate information.

It consists of an excavation carried down 37 feet until the chalk is reached; from this point a bore descends to the depth of 173 feet 8 inches below the surface. The excavation is 5 feet in diameter, and is lined in its upper part with bricks in cement and its lower with iron cylinders to keep out water from the superficial soil. Further description of the well is hardly called for here, since the water drawn from it was never seriously suspected of having been the means of disseminating disease. Moreover in addition to bacterioscopic examination by Dr. Klein of water from the Workhouse and Infirmary wells, samples from both were submitted to Dr. Frankland for chemical examination. He pronounced the former bad and the latter good.

Here then was a case against the water which seemed at first almost conclusively to incriminate it as the cause, or at any rate the vehicle, by which the disease was distributed.

With, however, further progress of the inquiry, grave doubts began to be thrown upon the water hypothesis. Not only was it seen that closure of the Workhouse well failed to at once put an end to the outbreak, but also it was found that the children, who were the chief consumers of the water, and who drank it at their meals and frequently at other times, were in effect exempt from attack. And conversely it became evident, in the course of a case to case inquiry which I conducted, that amongst the adult inmates, and more especially the females, consumption of water in an unboiled condition had been exceptional. Water when taken at all had been almost invariably consumed after infusion with tea, and—a point about which the female inmates are scrupulously particular—the water with which the Workhouse tea was infused had been actually boiling at the time the tea was made.

And here it should be said that in inquiring into the habits of the inmates with regard to the consumption of water, I took especial care to eliminate, as far as possible, all error by classing any of those concerning whom there was the least doubt, as "water-consumers"; and those who either cleansed their teeth or washed their mouths with water, were similarly classed. In all cases when the patient was in bed at the onset of the attack, I was able to check their statements by reference to the attendants. On the above lines I cross-questioned 129 of those attacked, and 28·6 per cent. were found never to have used unboiled water.

It became manifest, therefore, that although there appeared *prima facie* grave suspicion of the Workhouse water as having been the medium by which the disease was conveyed to the Workhouse inmates, and notwithstanding that the water in question was found to be polluted, the facts subsequently elicited failed to justify the inference that the disease had been waterborne.

Accordingly I passed to the question whether any article of food could be held to have been either the cause or the medium of conveying the disease.

Food.

The food supplied to the Workhouse and to the Infirmary is furnished by the same contractors, and is delivered to both establishments at the same time and in the same vans. For some time antecedent to the outbreak all food supplies received into the Workhouse passed directly through the hands of the Master, in consequence of the cook having left the service on September 12th; and the cook's successor was not appointed until after the outbreak was in progress. The Master stated that during the whole of that time no complaints as to the quality of the food reached him; though, of course, this is not a point of much consequence.

For the most part, articles of diet used in the Workhouse are also used in the Infirmary. The food requiring to be cooked is prepared separately for the Workhouse and for the Infirmary. The staff are furnished in some instances with food of a rather better quality than the inmates, and this is the case, amongst other things, with regard to bacon, cheese, butter (the inmates are supplied with margarine of Dutch origin), tea, and coffee. No fish or tinned meats had been consumed by any of the Workhouse inmates. A copy, both of the Workhouse and Infirmary dietary scales, will be found annexed to this report, as also a table, Addendum No. 5, showing the daily incidence in the Workhouse of the disease upon each dietary class.

Notwithstanding that both the Workhouse and the Infirmary were supplied with food by the same contractors, and that the supplies were delivered at the same time in the same vans, the outbreak was confined, as has been seen, practically to the Workhouse. The only articles of diet which were used in the Workhouse and not in the Infirmary were oatmeal porridge, pea-soup, and suet pudding; and a glance at the diet tables and at the incidence of the disease on the respective classes for diet, will be sufficient to at once exonerate any of these articles from blame. For the rest, the Workhouse diets were divided into four classes * Nos. 1, 4, 5, and "extra labour." These four diets comprise articles which may be enumerated as follows :—

1. Bread.	7. Suet pudding.
2. Oatmeal porridge.	8. Irish stew.
3. Meat.	9. Tea.
4. Bacon.	10. Butter
5. Potatoes.	11. Beef-tea.
6. Pea-soup.	12. Milk.

Each of these articles of food was separately considered in its possible relations to the outbreak, but in every instance with negative results. Thus—

(1.) *Bread.*—This article of diet was common to each dietary class, and was consumed alike by adults and children. But as has been seen,

* The four diets severally include—

No. 1 Diet.—Bread, oatmeal porridge, meat, potatoes, pea-soup, suet pudding, and Irish stew. Bacon once a week.

No. 4 Diet.—Bread, beef tea and milk.

No. 5 Diet.—Bread, butter, tea, meat, potatoes, pea-soup, suet pudding, and Irish stew.

Extra Labour Diet.—Bread, butter, tea, meat, and potatoes.

the children kept separated from the adults remained, with the exception of one case, free from the disease, and the Infirmary inmates who consumed the same bread were practically exempt from illness.

(2.) *Oatmeal Porridge* was consumed in the Workhouse by the able-bodied inmates alone, and only by those on No. 1 diet, but the outbreak was by no means confined to these persons.

(3.) *Meat.*—It was at first surmised that the outbreak might have been due to the consumption of New Zealand mutton, which is received into the Workhouse and also into the Infirmary in a frozen condition.

It soon, however, became apparent that this surmise was based on a too hasty generalisation, though it is not difficult to understand how the mutton came to be suspected; the majority of those attacked consumed mutton, and in some wards the only persons attacked were those into whose diet mutton entered. But on the other hand it had not been perceived that a considerable proportion of inmates who had no mutton at all nevertheless suffered in the outbreak; nor that in some wards, where the patients were all on mutton, no attacks took place. Furthermore mutton had been in common use in the Infirmary, which practically escaped attack.

(4.) *Bacon.*—This article of food was consumed only on Tuesdays, when all the patients, with the exception of those on No. 4 diet (beef-tea, milk and bread, and mutton), had an opportunity of taking it. The inmates on No. 4 diet were, however, by no means exempt from illness, no less than 21 per cent. of them being attacked.

(5.) *Potatoes.*—No potatoes were consumed by persons on No. 4 diet, who, as above seen, suffered considerably in this outbreak, while the children, who also consumed potatoes, were almost entirely exempt.

(6.) *Pea-soup* was not consumed by Workhouse inmates on extra labour diet, who suffered to the extent of 7 per cent. of their numbers. It was, however, partaken of by wardswomen and wardsmen, who were, as will be seen later, attacked in an exceptional degree.

(7.) *Suet-pudding.*—This was not included in the "extra labour" and No. 4 diets.

(8.) *Irish Stew.*—Had the same distribution as six and seven.

(9.) *Tea.*—The staff consumed a different tea to the inmates, and, as presently will be seen, they suffered severely in the outbreak. Moreover, inmates into whose dietary scale tea did not enter, were by no means exempt.

(10.) *Butter.*—With regard to butter (margarine), none was used by the Workhouse inmates on No. 1 and No. 4 diets, both of which classes suffered in the outbreak.

(11.) *Beef-tea* being only included in diet No. 4, may accordingly be excluded.

(12.) *Milk.*—This article of food was consumed only by children, and by adults on No. 4 diet, and the practical escape of children appeared inconsistent with any relation of the milk supply to the outbreak.

As to Infectivity of the Disease.

The evidence, therefore, having tended decidedly to exclude the water and the food at the Workhouse as media by which the disease spread among the inmates, it became necessary to consider whether after all the disease may not have been spread, as measles is, directly from person to person, or mediately by fomites, infected bedding, and clothing.

Early in the inquiry, it appeared to the medical officers of the Infirmary and myself that there were numerous facts in the history of

the outbreak that were quite consistent with possession by the disease of considerable infective power; and consequently everything, so far at least as the circumstances would allow, was at once done, by means of isolation and disinfection, to prevent its spread. The patients were transferred to and isolated in a separate block of the Infirmary, and all excreta, vomit, &c., as well as infected clothing, were carefully disinfected. Visiting between the Workhouse and Infirmary, as well as between both and the outer world, was suspended. And, as a matter of fact, when these measures were effectually carried out, the disease ceased to occur.

Among considerations tending to encourage belief in the infectivity of the disease are the following :—

In the Infirmary, which it will be remembered is an entirely separate building from the Workhouse, two well-marked attacks occurred in the course of the outbreak at a date antecedent to removal of cases from the Workhouse to the Infirmary. One of these was a male, the other a female, and they occupied different wards in separate blocks of the Infirmary. The male was attacked on Oct. 11th, the female on Oct. 12th, both attacks being quite typical of the general outbreak. On Oct. 10th the patients in the Infirmary had been visited by relations and friends from the Workhouse; and although it appears that neither of the inmates of the Infirmary that were attacked had personal friends visiting them on Oct. 10th, it is extremely probable, since they were both up and about in their wards, that they came then in contact with some of the visitors from the Workhouse, where there occurred on that day no less than 31 fresh attacks.

As regards the secondary cases in the Infirmary, the case of Nurse H., for instance, is difficult of explanation otherwise than by infection. She was the only nurse attacked in the Infirmary, and was in charge of one of the wards where some of the patients from the Workhouse were under treatment. In another instance one of the male employés in the Infirmary, who resided with his family outside the institution, was attacked with symptoms that Dr. Burney considered typical of the outbreak. This man was sent to his home, and a few days afterwards one of his children, who had not been inside the Workhouse or Infirmary, was attacked with similar symptoms. It should be stated that this man, although employed in the Infirmary, had visited the Workhouse from time to time previous to his illness.

The immunity of the children that were confined to the nurseries is best explained by regarding the disease as infectious. These children were for the most part kept entirely apart from the remainder of the inmates. They had a nursery and dormitory of their own, and playgrounds for their sole use; all their meals were taken apart from the adults, and in a different building.

On a theory of spread of the malady by infection it was to be expected that an excessive, or at any rate exceptional, incidence of the disease would be found among those brought most in contact with infected persons or things; *i.e.*, that the nurses and others in attendance in the wards, and the persons brought in contact with infected linen, &c., would be especially liable to attack. And on examination this was found to be the case, as follows :—

The Incidence of the Disease upon the Laundry Staff.

The laundry of the Workhouse, which is well constructed and ventilated, is situated at the eastern extremity of the "old infirmary." The

soiled linen is brought here from the wards by the wardsmen and wardswomen, deposited in the sorting room, and distributed to the various departments of the laundry. Linen, however, that is found coarsely fouled is received into a separate room, where it is soaked, before washing, in a tank containing a solution of Sanitas.

The laundry is worked by pauper labour, there being an average number of 50 inmates employed at the work. Among these 50 persons there were four attacks; and it is an interesting point that among the four were the only persons (two) engaged in dealing with the coarsely fouled linen. The two persons in the foul linen department were both attacked, whereas of 48 persons employed in the general department of the laundry, only two attacks occurred. Of course this attack rate of 100 per cent. upon those employed in the foul linen department may be only a coincidence, or may have other explanation than that suggested; but at any rate it is of value in summing up the evidence for or against infectivity of the disease.

Incidence of the Disease on the Wardswomen and Wardsmen.

The average number of wardswomen in the Workhouse is 34, and of wardsmen 24. These 58 persons assist in attending upon the other inmates, and in keeping the wards clean, &c. It would therefore be only reasonable to expect, assuming the disease to have been infectious, an exceptional incidence upon these individuals, since they would certainly be more likely to be brought into frequent and close contact with infected motions and vomit than the other inmates. This expectation has been fully realized, as out of 34 wardswomen, no less than 9 (or 26·5 per cent.) were attacked, while out of the 24 wardsmen, 6 (25 per cent.) were attacked.

Incidence on Administrative Staff.

The Workhouse Staff.—This consisted of the following persons, whose ages ranged from 20 to 51 years:—

Master - - -	1
Matron - - -	1
Assistant master - -	1
„ matron - -	1
Porter and wife - -	2
Labour masters - -	2
Receiving wardsman - -	1
Storewoman - - -	1
Cook - - - -	1
Laundresses - - -	2
Day nurses - - -	10
Night nurses - - -	2
	25

There were in addition to the above, two resident medical officers whose services were common to both Workhouse and Infirmary.

Of the total (25) Workhouse staff, four, or 16 per cent., were attacked, and all four attacks occurred among the twelve nurses in attendance upon patients suffering from the disease. It will thus be seen that the incidence upon these nurses was very considerable *i.e.*, 33·3 per cent.

App. C.

Outbreak of Diarrhœa at Infirmary, Greenwich Workhouse, Oct. 1886, by Dr Buisté de

Infirmary Staff:—

Matron	1
Assistant matron	1
Steward	1
Head nurses	5
Nurses	29
Assistant nurses	6
Night superintendent	1
Male and female receiving attendants	2
House porters	7
	53

There was, so far as I am aware, but one nurse attacked amongst the Infirmary officers, and she was on duty in the block containing patients removed from the Workhouse for isolation into the Infirmary. This nurse was attacked on October 16th.

Whether this comparatively trifling incidence on the Infirmary staff may be accepted as testimony to the efficiency—as compared with the means adopted at the Workhouse—of the measures taken in the Infirmary for dealing with cases considered to be infectious, or is to be regarded as tending to discredit belief in the infectiousness of the malady that is in question, must be left to the judgment of the student of this report.

The greater incidence of the malady upon female than upon male inmates of the Workhouse certainly would seem consistent with infectiveness of the malady; though the observed difference may have been partly due to a greater natural tendency on the part of the females to make mention to the nurse or to one another of their ailments. Moreover, seeing that in both sexes a very large number of those attacked were inconvenienced only very slightly by their illness, and did not take to their beds, it is like enough that males would resort to the closets out of doors, and say nothing about the matter, whereas the females congregated together in their wards could not fail to observe the frequency of one another's visits to the closets. On the other hand, the greater tendency of females to sit by one another's bedsides, &c., would considerably increase the chances of infection, as also would the common use of a badly-flushed W.C., situated in some cases practically inside the ward. But, under equal conditions of confinement within doors, there did not appear any excess of incidence on females. Thus, in the West Block, where 119 infirm males were dealt with under exactly similar circumstances to 119 females in the East Block, there were 37 attacks, whereas in the East Block the attacks were only 29.

In exactly what way infection may have passed from the bodies of persons attacked to other persons it is impossible to say; but, having regard to the fact that the digestive system was always chiefly implicated at the onset of the malady, it may be believed, perhaps, that infection contained in the motions and vomit of the infected persons was conveyed from person to person by means of these ejecta. Transmission of infection by such means may have taken place in different ways. In the case, for instance, of the nurses and attendants on the sick, by direct personal contact with the excreta; in other cases, perhaps, by ingestion (after lodgment in the mouth) of particles of infective matter wafted about the crowded wards by air currents. Spread of diarrhœa from person to person in some such way, without actual personal contact, has already been noted elsewhere. Several localized outbreaks of infective diarrhœa, which occurred in the Rural Sanitary District of Helmsley in Yorkshire in the years 1876, 1880, 1882, and

1886, are recorded by Dr. Bruce Low in the supplement to the report of the Medical Officer for the year 1887.

The Nature of the Disease.

It will be well, in considering this question, to recall the fact that the Greenwich outbreak occurred at a season during which isolated cases, and small groups of cases, manifesting all the symptoms of Asiatic cholera and bacteriologically indistinguishable from that disease, were being reported from various parts of the country, and also in the Metropolis. The symptoms in the case of Harriett C——, the death of whom first attracted attention to the Greenwich outbreak, were certainly such as to suggest Asiatic cholera, and also the more severe cases at the Greenwich Workhouse seemed capable of being so regarded. It is true that the fatality of the Greenwich attacks was far below that usually observed in well-marked Asiatic cholera. But having regard to the frequently observed diminution of cholera fatality towards the termination of epidemics of that disease, the small fatality of the Greenwich malady did not necessarily entirely negative belief in its choleraic nature. Furthermore, when the motions of those first attacked at Greenwich were microscopically examined by Dr. Klein, suspicion that the outbreak was due to cholera was rather enhanced than diminished. It was in fact only when the material from these persons was submitted to the further scrutiny of cultivation and chemical test, that doubt was thrown on the strong indications of the primary microscopical examinations of their crude evacuations. The onset of the disease in individuals attacked at Greenwich bore, too, one may say, generally a very strong resemblance to cholera. In numerous cases premonitory diarrhœa, such as frequently ushers in attacks of Asiatic cholera, was present; and in many cases where such diarrhœa was absent, the sudden seizure characteristic of severe cholera attack was manifest. Certainly in the majority of the Greenwich cases, in which premonitory diarrhœa was not complained of, the attack commenced suddenly in the early morning. And as regards the onset of Asiatic cholera, I quote the following from Fagge's "Principles and Practice of Medicine." "It very often—" "according to Lebert in more than half the cases—begins in the early "morning, perhaps waking the patient from sleep." The motions and vomit of the Greenwich cases were, on the other hand, by no means characteristic of Asiatic cholera, and although in a few instances they were thought to approach somewhat to a rice-water character, as a rule this was certainly not the case.

The post-mortem appearances of those persons at Greenwich who died of the disease were, except in one important particular, not inconsistent with death from Asiatic cholera; although it must be admitted that this statement is based upon the fact that the appearances were in a large part negative. The one common feature about all the post-mortem examinations under consideration, which must certainly be held to throw grave doubt upon the cholera theory, is the entire absence in the intestines after death of anything resembling a rice-water motion. The bowel contents in all the autopsies are reported to have been bile stained.

When, too, we examine into the age distribution of the disease at Greenwich Workhouse, it must be admitted that, having regard to the marked immunity of the children, a theory of cholera, and above all, of water-borne cholera, not only fails to receive any support, but, on the contrary, there are seen to be considerations militating against it. True, but little appears to have been written upon the age incidence of Asiatic cholera, but I am able to furnish an interesting table, showing

the experience, in 1892, of Hamburg in these respects.* It serves as a standard of age incidence of the disease in the recent manifestation of cholera in Europe, and it indicates that children—especially children under five years—are, when exposed to a common cause of cholera, by no means exempt.

Age Period.	Population, December 1891.	Cholera.		Rates per 1,000 Population	
		Attacks.	Deaths.	Attacks.	Deaths.
Under 1 year of age -	18,635	697	626	37·4	33·6
„ 1 to 2 years - -	15,434	624	490	40·4	31·7
„ 2 to 3 - - -	14,537	432	289	29·7	19·9
„ 3 to 4 - - -	13,936	348	219	26·9	16·9
„ 4 to 5 - - -	12,616	297	175	23·5	13·9
Under 5 years of age - -	74,158	2,398	1,799	32·3	24·3
„ 5 to 15 - -	122,444	1,731	776	14·1	6·3
„ 15 to 25 - -	125,390	1,959	744	15·6	5·9
„ 25 to 50 - -	237,013	7,127	3,520	30·1	14·9
„ 50 to 70 - -	66,858	2,002	1,369	29·9	20·5
Aged 70 and upwards - -	14,025	486	376	34·6	26·8
Unknown - - -	512	1,253	21	—	—
Totals - -	640,400	16,956	8,605	26·3	13·4

Finally, it will be seen from Dr. Klein's report, which is appended, that from the bacteriological point of view he is unable to regard the Greenwich malady as cholera.

As to the Relation of the Greenwich Malady to Influenza.

Early in the inquiry the possibility of the outbreak being of a gastro-intestinal variety of influenza had to be considered, and in this connexion it should be noted that at about the time the outbreak occurred recurrence of influenza was being reported from various parts of the country.

As regards the Workhouse itself, I was informed by Doctors Burney and Keats that no cases bearing any resemblance to influenza in any of its forms had come under their notice during the four months preceding the outbreak; and Dr. Hartt, Medical Officer of Health for Greenwich, had heard of no cases in Greenwich for a considerable time antecedent to this outbreak.

It seemed to me therefore, and still seems, improbable that so many cases of influenza, characterized all of them by gastro intestinal symptoms, should have occurred with no intermediate forms whatsoever. Of course it is difficult either to prove or disprove a proposition of this kind, and unfortunately neither age nor sex incidence can aid in this connexion. Furthermore, it is difficult to determine exactly what value is to be attached to the presence or absence of the bacillus discovered independently by Pfeiffer, Kitasato and Canon, and regarded by them as the cause of influenza.

It will be seen, however, from Dr. Klein's investigations that the bacillus which he isolated from material afforded by the Greenwich cases, and which he appears to think may have been the cause of the outbreak, though bearing some resemblance to the influenza bacillus, differed in essential particulars from that microbe.

* Bericht des Medicinal—Inspectorats über die Medicinsche Statistik des Hamburgischen Staates für das Jahr 1892 by Dr. Reincke, pp. 31, 32.

The Malady observed at the Workhouse not limited to that Institution.

Soon after the commencement of my inquiry, I heard of cases of similar type to those in the Workhouse as having occurred in Mill Lane, Deptford. I was, however, unable to obtain any evidence, which I could regard as conclusive, that cases had arisen there prior to October 4th, the date on which the first case was heard of in the Workhouse. At a later stage in my investigations I was, by the kindness of Dr. Roberts, Medical Officer of Health for Deptford, enabled to obtain information of two deaths in adults which had resulted from diarrhœa and vomiting in his district. In one of the cases the history and all the symptoms bore an exact resemblance to the worst cases of the Greenwich outbreak. But although I spent a considerable time in endeavouring to trace out any connexion between them and the Workhouse, I was unable to do so; moreover, Dr. Roberts informed me that he had made careful inquiries at the houses of persons who had received, or who were stated to have received, visitors from the Workhouse, but he had been unable to ascertain the existence of any cases in such houses.

With respect, however, to Greenwich, my inquiries were more successful. At first it appeared that no cases had occurred outside the Workhouse, but subsequently, owing to information which came to my knowledge, partly by the kindness of Mr. Jordan, master of the Workhouse, I was led to suspect that the existence outside the Workhouse, of a disease similar to that which prevailed inside, had been by no means rare. In my inquiries in this direction, as also in others, I have to acknowledge the very material aid afforded me by Dr. Hartt, Medical Officer of Health for Greenwich. He was good enough to send a circular letter to all the medical practitioners in his district, asking to what extent diarrhœa and sickness, especially amongst adults, had been prevalent in their practices for some time antecedent and during the outbreak at the Workhouse. By the courtesy of these gentlemen, I was able to obtain information of a most valuable kind, which established the fact that there had been prior to and simultaneously with the outbreak in the Workhouse several cases of an exactly similar description in some parts of Greenwich, more especially in that part where the Workhouse is situated. The earliest cases of which I was able to obtain information were two which occurred not far from the Workhouse, on September 28th—*i.e.*, a week before the Institution was invaded—and subsequently to that date there occurred in the practice of some of the medical practitioners in Greenwich over twenty cases of a similar character. Two of these cases were those of medical men in attendance upon patients suffering from similar attacks, and the description which they were good enough to give me of their seizures (which were inexplicable upon any thesis of water or food ingestion) corresponded precisely with the typical attacks occurring in the Workhouse. There were not amongst those attacked with symptoms of this sort outside the Workhouse any deaths, but it did not appear that in Greenwich outside the Workhouse any persons of an advanced age had suffered from the illness.

From all the facts here adduced, I conclude that, in all probability, the disease which spread so widely amongst the inmates of the Greenwich Workhouse was introduced into that institution from without. By what person or by what agency it was so introduced, I was unable to ascertain. Having once been introduced, it may have spread, so at least the balance of evidence would seem to indicate, rather by means of personal infection and infected dejecta, and the like, than by the agency of any common vehicle such as water or food.

ADDENDUM No. 1.

App. C.

On an Outbreak of Diarrhœal Illness at Greenwich Workhouse, Oct. 1887. By Dr. Klein, &c.

Report by Dr. Klein on the Results of Bacteriological Examination of Material from the Bodies of Inmates of the Greenwich Workhouse attacked by Diarrhœal Illness.

No. 1.—H. C., *æt.* 71, an inmate of the Greenwich Union Workhouse, died on the morning of 11th October, while on a visit at Lambeth. From this case I received after the post-mortem examination on October 12th a piece of ileum. The gut was intensely congested, and it contained a brownish slightly blood-tinged fluid. On microscopic examination crowds of bacilli were detected, some very short cylinders, others long; some also that were threadlike. Among them were present some few forms that looked not unlike commas, and here and there also a free flagellum. Cultivations made in peptone salt solution and in gelatine plates yielded negative results; no commas made their appearance.

No. 2.—Fluid vomit of F., received October 13th. On microscopic and cultural examination, no commas could be detected.

No. 3.—Semi-fluid brownish fœcal stool of J. Received on October 13th. Microscopic and cultural examination yielded negative results as regards commas.

No. 4.—A piece of ileum from the body of J. C. Received October 13th. The specimen was deeply congested, and contained a brownish fluid. On microscopic examination flakes were found, consisting of epithelial cells with crowds of bacteria, the latter represented by short oval or cylindrical rods, and by threadlike forms. A few suspiciously comma-shaped bacilli were also found. Cultivations made in peptone salt solution, and in gelatine plates, did not, however, yield commas.

No. 5.—A stool of F. (see also No. 2). Received October 16th. This material was semi-fluid, brownish and distinctly fœcal. Amongst the crowds of bacteria contained in it were some which were distinctly comma-shaped, with flagella attached to them. There were also present free flagella. Cultivations were made in peptone salt solution. After 10 hours incubation at 37° C. the culture medium had become slightly turbid, and preparations made from the top layers showed a distinct crop of commas. Sub-cultures were therefore made in fresh peptone salt solution, and also in gelatine plates, and both media yielded almost pure growths of comma-shaped bacilli. But they were not true cholera commas; for they grew much more rapidly in gelatine than Koch's bacillus, and they liquefied this medium with rapidity, making it turbid. In peptone salt solution, they grew only slowly at 37° C., much more rapidly at 20° C.; moreover when grown at 37° C., they gave no cholera red reaction. On potato they formed, when grown at 37° C., after 2-3 days a brownish growth. On comparing them with Finkler's commas they were found to resemble this organism in every respect. A second stool obtained later from the same patient yielded on microscopic and cultural examination only negative results.

No. 6.—Ileum from the body of P. The specimen was much congested, and contained brownish fœcal semi-fluid matter, in which were crowds of bacteria. Cultivations proved negative.

No. 7.—A piece of ileum from the body of W. N. Received October 17th. The gut was deeply congested in parts. It contained no fluid, only greenish fœcal matter. In its epithelium, scraped from the mucous membrane, there were found crowds of straight bacilli, some oval, some cylindrical, others filamentous. They were all of the same thickness, and might therefore belong to one species. Cultivations proved negative as regards comma bacilli.

No. 8.—A fluid greenish stool of F. G. Received October 17th. Numerous bacteria were found in this specimen, but no definite commas. Cultivations proved negative; no comma bacilli appeared in them.

No. 9.—A piece of ileum from the body of M. M. Received October 17th. The specimen was deeply congested in patches, and contained semi-fluid yellowish brown fœcal matter. Samples under the microscope showed a considerable number of threadlike chains of bacilli, with single cylindrical and oval rods. Cultivations were made, but the result was negative as regards commas.

No. 10.—A fluid brownish stool of B. F. Received October 17th. Amongst a crowd of straight bacilli (oval, cylindrical, and threadlike

chains) there were some undoubtedly comma-shaped bacilli, and also some free flagella. Cultivations were made in a considerable number of tubes of peptone salt solution, as well as in gelatine plates, but the result was negative; no colonies of comma bacilli appeared.

No. 11.—A brownish fluid stool of M. H. Received on October 17th. Amongst crowds of bacteria there were a few bacilli which might be taken for commas, and also a few flagella. Cultivations were made in several tubes of peptone salt solution and in several gelatine plates, but the result was negative as to comma bacilli.

No. 12.—A brownish fluid stool of E. C. Received October 20th. This person lived in Mill Lane, Deptford, not in the workhouse. The material contained numerous mucous (non-epithelial) flakes, in which were crowds of bacteria, singly and in clumps, apparently bacillus coli. In addition there were present some thin cylindrical and filamentous chains of bacilli. Amongst the latter cylindrical bacilli were some which looked slightly curved, as well as some long thin homogeneous spirals. Cultivations were made in several tubes of peptone salt solution, and in several gelatine plates, but the result was entirely negative. No comma bacilli made their appearance.

Regarded from the pathological view point, the malady from which the foregoing persons suffered cannot be considered true cholera.

Not one of the stools submitted to me had the rice-water character, nor did any specimen of ileum received by me contain "rice-water" material. Moreover, in no case did culture of these materials in peptone salt solution yield unquestionable cholera comma-bacilli. It is of course quite possible to fail now and again in cases of true cholera to obtain positive evidence of the presence of the cholera commas. Others besides myself have recorded such failure. But seeing that from not one of the many samples tested could the cholera bacillus be isolated by peptone culture —a medium which I have elsewhere pointed out is almost infallible in picking out cholera commas from among multiple and similar microbes— there is no escape from the inference that these Greenwich cases were not of the nature of true cholera.

Nevertheless this Greenwich malady was characterised by the presence in the evacuations of certain living patients, and in the bowel contents of not a few of the fatal cases, of a definite micro-organism. Morphologically this organism was a bacillus, occurring either in oval or cylindrical rods or as filamentous chains. In well stained and well washed preparations these bacilli appear peculiar in the circumstance, that individuals show a faintly stained sheath with a stained granule at each end; the shorter forms appearing like diplococci from their ends being rounded. In all cultivations from the Greenwich cases these bacilli appeared in large numbers. In the early peptone cultures of some of these cases they seemed the only bacilli present, and in the gelatine plate cultures numerous colonies of them could be recognised. In peptone or in both cultures these bacilli grow well and produce rapidly a uniform turbidity; in gelatine plates they appear after 24 hours as minute grey dots, which in 36 hours have formed small pits due to commencing liquefaction of the medium. After 2–3 days, each greyish white dot has enlarged, and appears granular, the zone of liquefied gelatine around it having increased and become slightly turbid.

Microscopic preparations made of the colonies of a gelatine plate, or of peptone, or of broth cultures, show the bacilli, whether in the form of short ovals, thin longish cylinders, or slender long and short filaments, as activity motile; the filaments either rapidly progressing and at the same time oscillating, or moving in a serpentine manner. In stained specimens these filaments are seen to be composed of rods, short, oval or cylindrical. All forms show in the single individuals the bipolar staining well marked. In thickness and in the pronounced bipolar staining the short forms resemble* the Influenza bacillus, as also in the circumstance that they form on agar circular flat translucent colonies, each with a minute white dot in the centre. But they differ from the Influenza bacillus in that they are motile, and that they grow well and rapidly liquefy gelatine at

* Further report and papers on Epidemic Influenza 1889–92, with an introduction by the Medical Officer of the Local Government Board (Eyre and Spottiswoode).

20°C. In motility, in the very great differences in length of these bacilli—length varying between short ovals and long threads—and in their rapid liquefaction of the gelatine, the Greenwich bacillus shows a very close resemblance to that well known common putrefactive microbe proteus vulgaris. But on closer comparison it is found that this Greenwich bacillus differs from the proteus in several cultural respects as follows:—

(*a*) Cultures of proteus have a malodorous putrefactive smell, those of the Greenwich bacillus have not.

(*b*) Liquefaction of the gelatine by the proteus organism is less rapid than by the Greenwich bacillus; moreover the aspect of the colonies in gelatine plates is different in the two cases.

(*c*) The proteus organism forms, in broth cultures at 37°C., nebulous fluffy masses; the Greenwich bacillus does not.

(*d*) The proteus organism forms on agar cultures large circular opaque colonies which are white in reflected light; whereas the Greenwich bacillus forms translucent small round colonies, grey in reflected light.

(*e*) On potato the Greenwich bacillus forms both at 20°C. and at 37°C. a thick yellowish layer, whereas the proteus forms a colourless layer under the same conditions.

(*f*) The Greenwich bacillus coagulates milk at 37°C. within 48 hours; the proteus does not coagulate milk.

Certain viscera—liver, spleen, and kidney—of several of the Greenwich fatal cases were, after hardening, examined microscopically in sections. A few bacilli, in size and appearance like those of the intestine described above, were found in the spleen. In the liver none were discovered; but the liver cells in many parts were noted to be in a state of fatty degeneration. In the kidney clumps and streaks of these bacilli were found in the connective tissue between the cortical and medullary portion, extending thence into both cortex and medulla; few of them, however, could be seen in the Malpighian corpuscles of the cortex. These bacilli stained well by Gram's method, and thereby are further distinguishable from the proteus vulgaris.

From the facts that I have recorded, it is to be inferred that the Greenwich bacillus is not the proteus vulgaris, although without doubt it belongs to the same group. There are indeed, several species, or at least varieties, in the proteus group, some of them having distinct pathogenic action on the human subject. Thus Bordoni Uffreduzzi has described* a proteus hominis of pathogenic character, which was derived from rags and which produced in ragsorters a fatal disease chiefly characterised by pneumonic symptoms; and I myself have described in connexion with the Carlisle meat poisoning cases an organism closely resembling the proteus vulgaris.† As regards the pathogenicity of the Greenwich bacillus, I find that subcutaneous injection of guinea-pigs with material from cultures of the microbe, produces local œdematous swellings with general constitutional disturbance, the animals soon becoming quiet and refusing to feed. After two to three days the local swelling diminishes in size and becomes firmer, the constitutional disturbance passes rapidly off, and by the end of a week all traces of the swelling have disappeared. On tame mice the bacillus acts virulently when injected subcutaneously. These animals die within 22 hours, and present about the seat of inoculation an extensive œdematous swelling, in which the bacilli are found in great crowds and whence they are easily recovered by cultivation. The intestines are much congested, relaxed, and full of mucus, which is sometimes bloodstained: the spleen is enlarged and dark in colour; the liver, kidneys, and lungs are congested. Cultivations made of a droplet of the heart's blood of the experimental mouse yield an abundance of the colonies of the bacillus. On feeding mice with cultivations (mixed with bread and milk) no result was produced.

In its virulence on subcutaneous inoculation of small doses into mice, the Greenwich bacillus differs from the proteus vulgaris, since small doses of proteus culture injected subcutaneously into these animals do not produce any such distinct or fatal result.

* Zeitschr. f. Hygiene, vol. 3.

† Report of the Medical Officer of Local Government Board for 1889-90, p. 223.

ADDENDUM No. 2.

Report by Dr. Klein on the Results of his Examination Bacteriologically of Water Samples from Greenwich Workhouse.

The following samples of water were tested bacteriologically:—

Sample A from tap of Nurse T's. room.
" B from Workhouse well.
" C from Infirmary well.
" D from tap of T ward, east block of Workhouse.

Sample A (*From the Nurse's Room*).—The following bacteria were isolated from this sample:—

1. A comma bacillus, which in its morphological characters, size, motility, comma, and S shaped forms, did not differ from the cholera vibrio. In cultural characters, however, it differed considerably from that microbe. Thus:—(*a*) It liquefied gelatine faster than the cholera vibrio; (*b*) Its colonies in gelatine plates grew quicker, and were larger than those of the latter; (*c*) In peptone salt solution at 37° C. it grew fairly well, but not so well as the cholera commas; whereas at 20° C. it grew much faster than these; (*d*) On potato it produced after 48 hours, at 20° and 37° C. respectively, distinct growth, but this growth, unlike that of the cholera vibrio, was colourless; (*e*) And, finally, it gave no cholera red re-action. Accordingly I was unable to identify this water comma with Koch's vibrio; and, on the other hand, it differed even more widely from the comma bacillus obtained by me from certain of the Greenwich cases so far as I was able to test the latter microbe.
2. Bacillus proteus vulgaris. This differed from the Greenwich bacillus obtained from the intestinal contents in the same points as does the common proteus.
3. Bacillus coli communis. In plate cultivations made of large quantities of the water* (the residue of 100–250 C.C. of water was used for each plate of phenol-gelatine) a considerable number of colonies of bacillus coli made their appearance.
4. The common bacillus fluorescens liquescens.
5. Bacillus fluorescens putidus.

Sample B. (*From the Workhouse well*).—Yielded the same species as Sample *A.*; except that this comma bacillus must have been present in less number. In every one of four peptone tubes made of Sample *A.*, this comma bacillus made its appearance, whereas only one out of four tubes inoculated with water *B.* contained it. Bacillus coli was also present in Sample *B.* in fair numbers.

Sample C. (*From the Infirmary well*).—Yielded bacillus fluorescens liquescens and bacillus subtilis. Also it yielded a motile non-liquefying bacillus which, in its yellow growth and inability to form gas bubbles in gelatine shake culture, differed essentially from bacillus coli.

Sample D. (*From the tap in the east block of Workhouse*).—Yielded bacillus fluorescens liquescens and putidus, bacillus mesentericus, and non-liquefying cocci.

* I have given a full account of this method in Appendix C. of Theodore Thomson's report to the Local Government Board on an epidemic of enteric fever in the borough of Worthing and in the villages of Broadwater and West Tarring in 1893 (Eyre and Spottiswoode).

App. C.

On an Outbreak [illegible] Workhouse, Oct. 1893, by Dr. Bulstrode.

ADDENDUM No. 3.

Water Analysis Laboratory,
The Yews, Reigate, October 24th, 1893.

Greenwich Union Workhouse.

The sample of well water sent to me from this workhouse was turbid from flocculent suspended matter. It contained a large proportion of solid matters in solution and a rather small proportion of organic matter, very little of which was of animal origin. It exhibited very strong evidence of previous sewage or animal contamination, and must, on this account, be condemned as unfit for dietetic purposes. It is very hard and therefore scarcely fit for use in washing.

(Signed) E. Frankland.

Local Government Board.

Results of Analysis expressed in Parts per 100,000.

Number of Sample.	Description.	Solid Matters. Total	Organic Carbon.	Organic Nitrogen.	Ammonia.	Nitrogen as Nitrates and Nitrites.	Total combined Nitrogen.	Previous Sewage or Animal Contamination.	Chlorine.	Hardness. Temporary.	Hardness. Permanent.	Hardness. Total.	Remarks.
8956	Greenwich Union Workhouse well water, Oct. 17, 1893.	52·60	·116	·019	·034	·945	·992	9,410	3·7	22·3	7·7	30·0	Turbid.

E. Frankland,
The Yews, Reigate.

Water Analysis Laboratory,
The Yews, Reigate, October 31st, 1893.

Greenwich Union Infirmary.

Herewith I enclose results of analysis of a sample of water from the well at the Greenwich Infirmary collected on October 23rd.

Except for its turbidity, this water is of excellent quality for dietetic purposes. It possesses a very high degree of organic purity. Its hardness is about the same as that of the water delivered by the Kent Water Company.

The cause of turbidity ought to be investigated; since, if caused by surface infiltration, the water might become injurious to health although chemical analysis might still show it to be of great organic purity.

(Signed) E. Frankland.

Local Government Board.

Results of Analysis expressed in Parts per 100,000.

Number of Sample.	Description.	Solid Matters. Total	Organic Carbon.	Organic Nitrogen.	Ammonia.	Nitrogen as Nitrates and Nitrites.	Total combined Nitrogen.	Chlorine.	Hardness. Temporary.	Hardness. Permanent.	Hardness. Total.	Remarks.
8973	Water from well at the Greenwich Infirmary, collected Oct. 23rd.	29·12	·021	·005	0	·129	·133	2·3	20·6	6·0	26·6	Turbid.

E. Frankland,
The Yews, Reigate, Surrey.

ADDENDUM No. 4.

TABLE showing, for the WORKHOUSE INMATES, the DAILY INCIDENCE of ATTACK on each AGE GROUP.

	Males.				Females.				Infants.	All Ages and Sexes.
Groups.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Sex.	Men.	Men.	Boys.	Boys.	Women.	Women.	Girls.	Girls.	Infants.	Totals.
Ages.	16–60.	60 and over.	9–16.	2–9.	16–60.	60 & over.	9–16.	2–9.		
Average Number of Inmates.	154	399	12	15	178	350	8	13	26	1,155
Date. October 1	—	—	—	—	—	—	—	—	—	—
„ 2	—	—	—	—	—	—	—	—	—	—
„ 3	—	—	—	—	—	—	—	—	—	—
„ 4	—	1	—	—	—	—	—	—	—	1
„ 5	—	—	—	—	—	—	—	—	—	—
„ 6	—	—	—	—	1	1	—	—	—	2
„ 7	—	—	—	—	4	8	—	—	—	12
„ 8	1	3	—	—	3	8	—	—	—	15
„ 9	3	26	—	—	7	27	—	—	—	63
„ 10	—	10	—	—	4	17	—	—	—	31
„ 11	3	5	—	—	11	13	—	—	—	32
„ 12	—	3	—	—	1	14	—	—	—	18
„ 13	1	6	—	—	2	7	—	—	—	16
„ 14	2	4	—	—	6	4	—	—	—	16
„ 15	2	4	—	—	3	3	—	—	—	12
„ 16	—	—	—	—	1	5	—	—	—	6
„ 17	—	—	—	—	5	2	—	—	—	7
„ 18	—	—	—	—	—	—	1	—	—	1
„ 19	—	—	—	—	—	—	—	—	—	
„ 20	—	—	—	—	—	2	—	—	—	2
„ 21	—	—	—	—	—	—	—	—	—	0
„ 22	—	—	—	—	1	3	—	—	—	4
„ 23	—	—	—	—	—	—	—	—	—	0
„ 24	—	—	—	—	—	—	—	—	—	—
„ 25	—	—	—	—	—	—	—	—	—	—
„ 26	—	—	—	—	—	—	—	—	—	—
„ 27	—	—	—	—	—	—	—	—	—	—
„ 28	—	—	—	—	—	—	—	—	—	—
„ 29	—	—	—	—	—	—	—	—	—	—
„ 30	—	—	—	—	—	—	—	—	—	—
„ 31	—	—	—	—	—	—	—	—	—	—
	12=7·7%	62=15·5%	0	0	49=27·5%	114=32·5%	1	0	0	238=20·6%
	Total Males attacked, 74=12·7%.				Total Females attacked 1 4=29·8%.					

ADDENDUM No. 5.

TABLE showing, for the WORKHOUSE, the DAILY INCIDENCE of ATTACK on each DIETARY GROUP.

Class of Diet	Diet No. 1.		Diet No. 2.		Diet No. 4.		Extra Labour Diet.		Mutton.*		Totals.
Sex	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	Including 26 Infants.
Average Daily Number on each Diet	134	156	207	8	13	25	76	60	150	306	1,155
October 1	—	—	—	—	—	—	—	—	—	—	—
,, 2	—	—	—	—	—	—	—	—	—	—	—
,, 3		—	—	—	—	—	—	—	—	—	—
,, 4	—	—	1	—	—	—	—	—	—	—	1
,, 5	—	—	—	—	—	—	—	—	—	—	—
,, 6	—	1	—	—	—	—	—	1	—	—	2
,, 7	—	3	—	—	—	—	—	—	—	9	12
,, 8	—	4	—	—	—	1	—	—	4	6	15
,, 9	—	6	9	2	1	1	—	3	19	22	63
,, 10	—	4	3	1	1	1	—	1	6	14	31
,, 11	—	7	4	3	1	1	—	1	3	12	33
,, 12	—	2	2	2	—	—	—	1	1	10	18
,, 13	—	2	4	1	—	—	—	1	3	5	16
,, 14	—	3	2	2	—	—	—	1	4	4	16
,, 15	1	1	2	—	1	—	—	—	2	5	12
,, 16	—	3	—	—	—	—	—	—	—	3	6
,, 17	—	3	—	1	—	—	—	1	—	2	7
,, 18	—	1	—	—	—	—	—	—	—	—	1
,, 19		—	—	—	—	—	—	—	—	—	0
,, 20	—	—	—	—	—	—	—	—	—	2	2
,, 21	—	—	—	—	—	—	—	—	—	—	0
,, 22	—	—	—	—	—	—	—	—	—	4	4
,, 23	—	—	—		—	—	—	—	—	—	0
,, 24	—	—	—	—	—	—	—	—	—	—	—
,, 25	—	—	—	—	—	—	—	—	—	—	—
,, 26	—	—		—	—	—	—	—		—	—
,, 27	—	—	—	—	—	—	—	—	—	—	—
,, 28	—	—	—	—	—	—	—	—	—	—	—
,, 29	—	—	—	—	—	—	—	—	—	—	—
,, 30	—	—	—	—	—	—	—	—	—	—	—
,, 31	—	—	—	—	—	—	—	—	—	—	—
Totals	1	49	27	12	4	4	—	10	42	98	248
Percentage attack on each dietary group.	0·4		10·1		30·8		7·1		9·1		20·6

* As in the first instance some suspicion attached to the mutton as having been the cause of the outbreak, I give here the number of inmates daily consuming that article of diet.

ADDENDUM No. 6.

Report on Result of Post-Mortem Examinations made on:—

Obadiah P., age 74, died 13th October 1893.

William N., age 76, died 15th October 1893.

Michael S. M., age 64, died 15th October 1893.

William C., age 68, died 12th October 1893.

William A., age 78, died 14th October 1893.

M. previously had left hemiplegia, C. had suffered from osteo arthritis, A.'s case was probably one of peritonitis; he had diarrhœa and vomiting with the peritonitis. In all these cases the features presented a pinched look as if the patients had died from some sudden exhausting disease; post-mortem rigidity was present, but not to any marked degree; the brain was normal; the lungs were normal, except in the cases of P. and M., which exhibited signs of old pleuritic adhesions; the œsophagus was normal; the heart was normal, the right side being full of clotted blood. The stomach of each with contents was removed and sealed up in jars. The spleen was normal, the liver was normal, the kidneys were normal, except those of C., which were granular and contained a few small cysts. The small intestines were nearly empty, any contents being a dark colour. The lower portion of ileum was removed and placed in a sealed jar.

The large intestines contained liquid stools, the colour of which was dark. The rectum was normal. The vessels of the intestines were much injected, more especially about the lower part of small intestine and cœcum.

The bladder was nearly empty, only containing a very small quantity of urine.

The peritoneum was normal to the touch and sight, except in the case of A., in which it was acutely inflamed, along with effusion of lymph.

Cause of death exhaustion from repeated vomiting and diarrhœa accelerated by old age.

Walter C. S. Burney,
Medical Superintendent,
Greenwich Union Infirmary.

Report on Post-Mortem Examinations of Female Cases.

Report on post-mortem appearances found in the bodies of Mary A., aged 77 years, died on Tuesday, October 10th, 1893, at 9 p.m.; Mary Ann W., aged 92 years, died 9.15 a.m., October 11th, 1893; Jane C., aged 86 years, died 6.30 a.m., 13th October 1893; Sarah H., aged 68 years, died at 9.30 p.m., October, 30th, 1893, after a relapse; Elsie T., aged 65 years, died also of a similar disease; but delay occasioned by informing coroner, who did not order a post-mortem, caused the body to become much decomposed.

The bodies were fairly well nourished considering the great ages of the subjects; post-mortem rigidity was present in all cases, but not to any great extent. The features were pinched in all cases. The brains and their membranes in all cases were normal.

In all cases:—

The *Mouth* was normal.

The *Tongue* was thickly furred.

The *Æsophagus* was normal.

The *Lungs* were normal, except those of Mary A., which presented evidence of old pleurisy and chronic bronchitis.

The *Heart* was normal; the right side was full of blood and the left empty. In the case of Jane C., the walls of the left ventricle were hypertrophied.

App. C.

Report of Coroner's Inquest at Greenwich Workhouse Oct., 1893: by Dr. Bulstrode.

The *Peritoneum* was normal; nothing like stickiness was observed.

The *Stomachs* were normal, except that of Mary A., which had three small black patches situated on the anterior wall near the greater curvature; the largest was about the size of a shilling. Contents of all stomachs opened were fluid; most of them were sealed up unopened in jars.

The *Small Intestines* were rather contracted, contents fluid; the colour of the latter varied from pale brown to darkish green.

The *Large Intestines* had liquid contents, the colour of which varied as in the case of the small intestines. The mucous membranes were occasionally a little roughened. In the case of Sarah H. the following appearances were noted:—About the splenic flexure of the colon was a clean cut, nearly circular, ulcer, the size of a three-penny piece, which had nearly perforated the wall of the bowel. From this point and towards the rectum ulcers gradually increased in number; they were most numerous about the upper portion of the rectum, where they nearly surrounded the bowel:

The size of the ulcers seldom exceeded that of a shilling; occasionally they ran into one another; their walls were usually clean cut with very little thickening. They were always situated on the side farthest away from the attachment of the mesentery. Their floors were dark red in colour; the ulcer in the splenic flexure was the deepest of all:

The vessels of large and small intestines were in all cases injected slightly, in some places more so than others; in the case of Jane C., the injection was intense, in that of Sarah H. especially so.

The *Spleen* was normal.

The *Liver* was normal.

The *Kidneys* were normal, except in the case of Jane C., in whom they were cirrhosed and showed small surface cysts.

The *Bladder* was normal; either contracted and empty, or containing one to three ounces of urine.

The Rectum was normal; the only exception being the case of Sarah H. mentioned above.

The *Uterus and its appendages* were normal except in the case of Jane C., whose uterus presented several fibroid tumours, rather larger than walnuts, which had undergone calcareous degeneration.

Portions of liver, kidney, and spleen, together with the stomach and lower portion of ileum, were preserved in sealed jars.

Cause of death: Exhaustion from repeated vomiting and diarrhœa, accelerated by old age.

Wm. J. C. Keats.

ADDENDUM No. 8.

Greenwich Union Infirmary.

Diet Table.

Class.		Breakfast.				Dinner.								Supper.
		Bread. oz.	Butter. oz.	Sugar. oz.	Tea. pints.	Bread. oz.	Meat, oz., or Stew, 1 pt.	Potatoes. oz.	Beef-Tea. pints.	Milk. pints.	Mutton Broth. pints.	Fish. oz.	Bacon. oz.	
1. Ordinary	Males	6	1	1	1	3	5 beef	8	—	—	—	—	4	Same as breakfast.
	Females	4	1	1	1	3	4 beef	8						
2. Mutton	Males	5	1	1	1	3	4 mutton	8	—	—	—	—	and greens in season on Wednesdays.	Ditto.
	Females	4	1	1	1	3	4 mutton	8						
3. Milk and Beef-Tea	Males	5	1	1	1	3	—	—	1	1	—	—	—	Ditto.
	Females	4	1	1	1	3	—	—	1	1				
4. Fish	Males	5	1	1	1	3	—	8	—	—	—	12	—	Ditto.
	Females	4	1	1	1	3	—	8	—	—	—	12		
5. Broth	Males	5	1	1	1	3	—	—	—	1	1	—	—	
	Females	4	1	1	1	3	—	—	—	1	1	—	—	

Stew.—24 oz. of meat in each gallon of liquor in which meat has been boiled, with the addition of mutton bones, 8 oz. of pearl barley, herbs and vegetables in season.

Broth.—½ lb. mutton, 2 oz. pearl barley, vegetables in season to 1 pint.

Beef-tea.—1 lb. beef to a pint.

Rice Pudding.—Rice 2 oz., sugar ½ oz., milk ½ pint, and 1 egg.

Tea to consist of—Tea 2 oz., milk 1 pint, sugar 4 oz. in a gallon.

Jelly, Formula { Gelatine, ʒ i. s.s. (Nelson's). Sugar, ʒ iv. Whiskey, ʒ x. Ess. Lemon, Acid. Cit. } to flavour. Water to make one quart.

Signed,

Medical Officer.

ADDENDUM No. 7.

Greenwich Union Workhouse

Dietary Scale.

—	No. 1. Able-bodied Inmates of all Ages.											No. 3. Infirm Inmates of all Ages.											Extra Labour Diet.								
	Breakfast.		Dinner.							Supper.			Breakfast.			Dinner.				Supper.			Breakfast.			Dinner.		Supper.		
	Bread.	Oatmeal Porridge.	Bread.	Meat.	Bacon.	Potatoes.	Pea Soup.	Suet Pud-ding.	Fish Stew.	Bread.	Marrow Pud-ding.	Oatmeal Porridge.	Bread.	Butter.	Tea.	Bread.	Meat.	Potatoes.	Pea Soup.	Suet Pud-ding.	Fish Stew.	Bread.	Butter.	Tea.	Bread.	Butter.	Tea.	Meat.	Potatoes.	Bread.	Butter.	Tea.
	oz.	pts.	oz.	oz.	oz.	oz.	pts.	oz.	pts.	oz.	pts.	pts.	oz.	oz	pts.	oz.	oz	oz.	pts	oz.	pts.	oz.	oz.	pts.	oz.	oz.	pts.	oz.	oz.	oz.	oz.	pts
Sunday	5	1	—	5	—	8	—	—	—	5	1	—	5	4	1	--	4	8	--	—	—	5	4	1	6	4	1		8	6	4	1
Monday	5	1	4	--	--	—	1¼	—	—	5	—	1	5	4	1	4	—	—	1¼	—	—	5	4	1	6	4	1	5	8	6	4	1
Tuesday	5	1	—	—	5	8	—	—	--	5	1	—	5	4	1	--	4	8	--	—	—	5	4	1	6	4	1	5	8	6	4	1
Wednesday	5	1	4	—	—	—	—	—	1¼	5	--	1	5	4	1	4	—	—	—	—	1¼	5	4	1	6	4	1	5	8	6	4	1
Thursday	5	1	—	5	—	8	—	—	—	5	1	—	5	4	1	—	4	8	--	—	—	5	4	1	6	4	1	5	8	6	4	1
Friday	5	1	4	—	—	—	1¼	—	—	5	--	1	5	4	1	--	4	8	--	—	—	5	4	1	6	4	1	5	8	6	4	1
Saturday	5	1	—	—	—	—	—	16	--	5	—	1	5	4	1	—	—	—	—	16	—	5	4	1	6	4	1	5	8	6	4	1

Note.—Cabbage is provided on Tuesdays when in season.

No. 4 Diet consists of Milk (1 pint), Beef Tea (1 pint), and Bread (12 ounces).

TWENTY-THIRD ANNUAL REPORT

OF

THE LOCAL GOVERNMENT BOARD,

1893–94.

SUPPLEMENT

CONTAINING THE

REPORT OF THE MEDICAL OFFICER

For 1893-94.

Presented to both Houses of Parliament by Command of Her Majesty.

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1894.

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PUBLIC HEALTH.

ANNUAL REPORT

OF THE

MEDICAL OFFICER

OF

THE LOCAL GOVERNMENT BOARD

FOR THE YEAR

1893-94.

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REPORT.

TO THE RIGHT HONOURABLE THE PRESIDENT OF THE LOCAL GOVERNMENT BOARD.

SIR,

IN submitting to you, for presentation to Parliament, my annual report on the proceedings of your Medical Department for the year 1893–94, I would recall the fact that I have already laid before you a special report on "Cholera in England in 1893."* That report embodied a history of the cholera occurrences in question, and also a statement of the measures adopted by the Medical Department to control the disease. Further reference to cholera in relation to this country will, therefore, be concerned only with such general measures of administration as became necessary owing to the prevalence of that disease in foreign countries. As yet I am not in a position to refer, in more than brief terms, to the prevalence of cholera abroad since the epidemic of 1892. That prevalence, however, involved a continued danger to this country, and it was hence decided early in 1894 to retain for a second year the services of the four temporary Medical Inspectors who had been appointed at the beginning of 1893.

I.—*ADMINISTRATIVE RELATIONS OF THE MEDICAL DEPARTMENT.*

1. VACCINATION AND PUBLIC VACCINATION.

The digest of Vaccination Officers' returns, which I submit in Appendix A., No. 1, includes a statement with regard to 914,079 infants whose births were registered in England and Wales during the year 1891. It is the twentieth annual return made since the passing of the Vaccination Act, 1871, and it shows that the per-centage of the infants in question who remained finally unaccounted for as regards vaccination was 13·4, a larger proportion than in any of the previous years. In the Metropolis the corresponding per-centage was 8·8 in 1872; and it fell to 5·7 in 1881; but since then it has steadily increased until it reached no less than 16·4 for 1891. In the provinces the per-centage of registered births not finally accounted for in 1872 was 4·5, and with trivial oscillations it remained at that figure for some 10 years, but since then the per-centage has increased until in 1891 it reached 12·9. Both in the Metropolis and in the rest of England the greatest increase in default under the vaccination laws, thus indicated, set in during 1889. I was in May of that year that the Royal Commission was

* Reports and Papers on Cholera in England in 1893, with an Introduction by the Medical Officer of the Local Government Board, [C.—7539] 1894.

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appointed to inquire into the subject of vaccination and since that date an increasing number of Boards of Guardians have more or less completely abstained from enforcing compliance with the law as to vaccination "pending the issue of the report" of the Commission. That report still remains to be issued.

Inspection of Public Vaccination.

During the year 1893 inspection of public vaccination was carried out by Medical Inspectors in 326 Unions. This inspection involved, as will be seen from Appendix A., No. 2, 1,429 Vaccination Districts, and in regard of 992 of these, situated in 291 Unions, the work of the Public Vaccinators was found to be such as to call for special recognition by way of award under section 5 of the Vaccination Act, 1867.

National Vaccine Establishment.

The lymph issued by the National Vaccine Establishment was derived from the usual sources. The humanised lymph received was stored on 1,040 ivory points and in 7,830 capillary tubes. Including requests from India, the Colonies and also the Diplomatic and other Services, 4,322 applications were received during 1893 for humanised lymph: and in answer to these 1,020 charged ivory points and 6,787 charged capillary tubes were sent out. The supply of lymph furnished from calves vaccinated at the Animal Vaccine Station, was received on 18,981 large ivory points and in 76 capillary tubes; and in answer to 2,797 requests for calf-lymph 16,177 of the charged points and all the 76 capillary tubes were sent out. (*See* Appendix A., No. 3.)

The proceedings of the Animal Vaccine Station, which are summarised in Appendix A., No. 4, included the performance of 7,683 primary vaccinations. Of the persons thus vaccinated 7,590 returned for inspection. In 54 of these, vaccination proved unsuccessful at the first trial, but in no case was a third attempt requisite to success.

Insusceptibility to Vaccination.

In his annual reports for 1887 and 1888 my predecessor the late Sir George Buchanan, drew attention to what is called "insusceptibility" of children to vaccination; the legal interpretation of the statutory term "insusceptible" being that vaccination has three times been unsuccessfully performed. In the former of the two reports reference is made to the following statement by Dr. Cory:—"Of my own vaccinations I may say that I "have in my time performed over 38,000 primary vaccinations "with human or with calf-lymph; and that it has only once "fallen to my lot to fail twice at an attempt at vaccination." Dr. Cory did not in the instance in question have an opportunity of making a third trial

Since the issue of that report 44,673 additional persons have been submitted to primary vaccination at the Lamb's Conduit Street Station; 43,591 of them having returned for inspection. In the case of these 43,591 vaccinations all but 218 succeeded at the

first attempt. In one case only did failure result on a second attempt, and in no case was there a third failure or legal insusceptibility. It thus transpires that, in the hands of vaccinators connected with the Board's Vaccine Department, operating at one time with humanised lymph, and at another with calf-lymph, not a single case of insusceptibility has been found amongst over 81,500 persons submitting to the operation of primary vaccination. Insusceptibility must needs be a rare phenomenon. But, notwithstanding this, certificates of "insusceptibility" are by no means uncommon in certain districts of England. Thus, of 98,871 children on whom the operation of primary vaccination was performed in Metropolitan Unions during 1891, no less than 432 were certified to be "insusceptible." The details of the proceedings of the Animal Vaccine Station in this respect since 1887–88 are set out in the following Table:—

Year.	Total Primary Vaccinations.	Returned for Inspection.	Vaccination failed.		
			Once.	Twice.	Thrice.
1888–89 - -	7,048	6,962	20	0	0
1889–90 - -	7,567	6,937	49	0	0
1890–91 - -	7,220	7,134	39	1	0
1891–92 - -	7,529	7,448	18	0	0
1892–93 - -	7,616	7,520	38	0	0
1893–94 - -	7,693	7,590	54	0	0
Total -	44,673	43,591	218	1	0

2. Other Administrative Business of the Medical Department.

The ordinary work of the Medical Department during the year 1893–94, was necessarily somewhat modified by reason of the continued prevalence of cholera on the Continent of Europe, and of the importation of that disease into this country under circumstances to which I have already referred in detail in my special report on Cholera in England during 1893. But a considerable number of local inquiries and of conferences with representatives of sanitary authorities were held as to such matters as sites for isolation hospitals, byelaws, &c., and in addition to these, as also to special inspections in localities where cholera was alleged to have occurred, 42 sanitary districts were visited and reported on by Medical Inspectors. Many of these visits of

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inspection were undertaken because of the evidence of excessive mortality from infectious diseases, afforded by the quarterly returns of the Registrar-General: others wee instituted by reason of statements contained in reports submitted to the Board by local medical officers of health; and others again were deemed necessary owing to the receipt of complaints as to local administration. In three of the latter instances the representations were received from County Councils, and in each instance a medical inspector was instructed to report to the Board as to the circumstances involved. An abstract of the 28 reports referred to will be found in Appendix A., No. 5. Some of these reports, however, call for more detailed notice, and they are consequently reproduced *in extenso*. The majority of these are concerned with the distribution of disease by reason of the contamination of public water supplies. This subject is one of pre-eminent importance to England, not only because, on the Continent of Europe, we are still face to face with cholera, a disease which owes its widest and most fatal distribution in this and other temperate climates to the agency of water contaminated by human excreta; but because even when the contaminating agent is insignificant in amount, and the point of contamination strictly localised, yet the resulting mischief is often as wide in its distribution as is the area of the particular water supply. In continuation, therefore, of the remarks which I had the honour of submitting on the subject of enteric fever and water supplies in my last annual report, I would now draw more particular attention to some further reports having a similar bearing.

Enteric Fever at Worthing.

The borough of Worthing, situated on our southern coast, was, during 1893, the seat of an epidemic of enteric fever, which is, in many respects, without parallel in the sanitary history of this country. The epidemic involved "Worthing" proper, and West Worthing, which together constitute the borough; and in addition the villages of Broadwater and West Tarring, which abut on the northern boundary of the borough. The great burden of the epidemic fell on "Worthing," where, on a population of some 15,300, there occurred no less than 1,257 attacks of enteric fever in the seven months, May—November, 1893. Including attacks during the same period in the other localities named, the total reached 1,411.

Investigation of the epidemic was rendered unusually difficult by reason of the complexity of the conditions involved. Not only did the incidence of the fever on the several localities implicated differ both in amount and as to time of occurrence, but differences and also correspondences between these localities in such matters as water supply, sewerage and drainage, proved so intricate as to render inquiry into their influence, if any, on the occurrence of the fever, no light labour. When, however, this labour had been undertaken, and its results formulated indication was obtained as to coincidence between the behaviour of the fever in one or other area, and the existence therein of

some particular condition or conditions. And in this way explanation was forthcoming as to the means whereby, at one time in "Worthing" and Broadwater, and at another time in West Worthing and West Tarring, the fever had been disseminated.

Dr. Theodore Thomson, whose report on the subject will be found in Appendix A., No. 6, recalls the fact that the previous history of Worthing, and the adjacent localities, in the matter of enteric fever, was distinctly favourable. Entire years had passed by without a death from that disease, and on but rare occasions had the borough death-rate from enteric fever even reached that for England and Wales as a whole. "Worthing" had also been practically free from the disease during the early part of 1893; but, following on a first case in the latter part of April, a sharp outburst of the disease took place in the first three weeks of May, and by May 28th no less than 268 attacks had occurred. Then came a marked abatement, but this was, in turn, followed by a further and rapid increase beginning about the middle of June, and culminating in an outburst of altogether exceptional magnitude in the early part of July. Indeed, in the six weeks, June 24th–August 4th, no less than 726 fresh attacks took place in the "Worthing" division of the borough. This occurrence was then once more followed by an abatement which, with occasional exacerbations, continued until the epidemic ceased as the month of December was reached. In point of time, the incidence of the disease on the village of Broadwater, resembled that on "Worthing;" but it was otherwise with the West Worthing division of the borough, and with the village of West Tarring, in which places the epidemic only manifested itself after the date at which the height of the epidemic in "Worthing" had been reached. During the earlier epidemic period in May, the public water service of Worthing had locally come under suspicion, and this suspicion was confirmed when it came to be ascertained as regards both "Worthing" and Broadwater, to both of which the "Worthing" water is laid on (1) that whilst there was heavy incidence of the disease on those of their inhabitants who were supplied with this water, there was all but immunity for those persons in the same areas who habitually drank water from local wells; and (2) that the West Worthing division of the borough and West Tarring village, which at this time were free from the epidemic, had altogether different water supplies. The "Worthing" public water-supply which, as came to be shown, caused the "Worthing" and Broadwater epidemic, is derived from three Chalk wells connected together by headings tunnelled in the same formation; the wells and works having in later years gradually come to be surrounded by an inhabited part of the town. With the increasing population in Worthing, it became necessary on several occasions to augment the water supply, and for this purpose, a large heading was early in 1893 driven from

the bottom of one of the wells, this work being commenced on March 13th. As the works progressed, it was found impracticable altogether to exclude from the public service some of the water entering the new heading through small fissures in the Chalk; and in the afternoon of April 14th, when a large fissure was struck, there was a sudden and great in-rush of water, which could not be controlled, and which from that date formed no small part of the total water-supply. In the fortnight ending April 28th, immediately following the in-rush of this water, there were no more than nine attacks of enteric fever in "Worthing"; but in the following fortnight, there were no less than 153, and simultaneously the outbreak manifested itself also in the village of Broadwater. Detailed investigation went to show that the soil, which to a depth of some 20 feet overlies the Chalk in the neighbourhood of the "Worthing" wells, was liable to sustained pollution by reason of leaky sewers; that access of any water lying in that soil to the public service must necessarily have involved risk of specific pollution of that service; and that the fissure which was struck on April 14th was actually in communication with the superficial soil in question. Herein, indeed, is to be found the explanation of the first phase of this epidemic; the precise source of the specific matter reaching the water remained, however, beyond actual proof. Chemistry had all along failed to detect in the water any definite impurity, and it was only in the later stage of the epidemic that the results of bacterioscopic examinations went to furnish conclusive evidence, not only of its being fouled by fæcal matter, but of its contamination by the specific material of enteric fever.

The fact that close upon 300 cases of enteric fever in "Worthing," occurred in the earlier period of the epidemic, April 29th–June 9th, may well, in view of the relation to the public water service of leaky sewers, which during this period must have been conveying typhoid dejecta, serve as an explanation of the great recrudescence which constituted the second phase of this serious epidemic which set in towards the end of June; but it does not account for the occurrence in West Worthing, and in the village of West Tarring, of an outbreak which, commencing as late as the fortnight ending July 7th, reached its maximum about one month after the culmination of the "Worthing" epidemic, and which, in the two places together, led by mid-October to the occurrence of 109 attacks. Enteric fever in these places could only in small part be assignable to use of "Worthing" water; for not only have both localities altogether different water supplies, namely, from the West Worthing water-works and from local wells, but the proportion of their inhabitants who by reason of business occupations, &c., would have had opportunity to use the "Worthing" water, was but small. Besides which, during the period April 15th–June 23rd, in which "Worthing" water was conveying the infection of enteric fever to its consumers, only a solitary case of that disease had occurred amongst the

2,186 people who formed the joint population of West Worthing and West Tarring. It was also shown that the distribution of the outbreak in these two places, bore no relation to the general distribution of the mains of the West Worthing water; on the contrary, it was limited in both localities to the lowest point on either slope of a ridge common to the two districts. And, after studying all the circumstances under which this latter outbreak took place, Dr. Theodore Thomson regards the evidence as pointing, not as was the case in "Worthing" proper to pollution of the water at its source, but to local infection of the water in certain of the mains.

Enteric Fever at Chester-le-Street.

Another outbreak of enteric fever which came under investigation is that which occurred during the winter of 1892–93 in the mining village of Chester-le-Street, and which was investigated and reported on by Dr. Maclean Wilson, one of the Board's temporary medical inspectors (*see* Appendix A., No. 7). Between October 1892 and the middle of the following March there occurred 58 cases and 4 deaths in 43 households. The total population of the village was 4,864 at the date of the last census. The principal incidence of the disease was upon two periods; 17 cases were notified between November 14th and January 24th, and 38 more between February 10th and March 19th, and the precise cause of the outbreak was somewhat obscured by the very general prevalence of faulty sanitary circumstances. There was overcrowding; sanitary shortcomings, some described as "glaring," attached to a number of the invaded houses; cow-sheds were found to be badly ventilated and unsuitable for their purpose; and the village as a whole is described as having many of the sanitary defects of the old country hamlet combined with those of the modern pit village. But, whether disposal of sewage and excreta, house accommodation, or milk supply be considered, none of these could be found to account for the distribution of the fever. Indeed, some of the earlier attacks in households occurred under sanitary circumstances which left but little to be desired. But when the supply of water came to be considered the matter was otherwise. Of some 1,100 houses in the village about 60 per cent. are supplied by the Chester-le-Street Water Company, the remainder deriving their supply from the Consett Company. With two exceptions, both included in a group of early attacks which could be etiologically separated from the general outbreak, every household attacked was found to be using the water of the Chester-le-Street Company; and this although the homes of the sufferers were not grouped in any particular part of the village, but were scattered over nearly every part of it. The water in question is taken direct from the Stanley Burn, and is thence conveyed to a filter bed before its distribution to the village. On examining the burn above the intake it was found to receive the sewage, either in its crude state or after certain processes of irrigation, from scattered villages of from 20 to 150 houses; and it was estimated by the

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local health officer that the sewage of a population of 3,500 persons found its way either directly or indirectly into the Stanley Burn and its tributaries above the intake of the Chester-le-Street Company. Three miles above this intake was a group of cottages, draining directly into a tributary of the Stanley Burn, where 4 cases of enteric fever occurred in October 1892, 10 other attacks following in January and February 1893. With regard to the process of filtration to which this water is subjected it is worth recording that the sand in use for the filter-bed was derived from the banks of the River Wear close by, and that the Wear above this point receives the "untreated sewage of a large population."

ENTERIC FEVER IN THE VALE OF PICKERING AND AT MALTON.

Amongst other occurrences of enteric fever which were inquired into by the Medical Department during the year under consideration were certain groups of attacks which were investigated by Dr. Bruce Low in villages situated on the banks of the River Rye in the Vale of Pickering, and in the neighbouring town of Malton on the Derwent. (Appendix A., No. 8.)

The villages in question were those of Nunnington and Ness in the Kirkby Moorside rural district, together with Butterwick and Brawby in the Malton rural district. After a period of almost complete absence of enteric fever, 31 attacks of this disease occurred in these four villages during the three months November 1892–January 1893, and careful inquiry into the causes of the fever made it clear that the disease could only be attributed to the use, for drinking purposes, of water dipped at each place from the River Rye. Not only was the incidence of enteric fever on the 600 inhabitants of these four riverside villages 60 times as great as on the remaining 17,000 to 18,000 people comprised in the two rural districts concerned, but within the four villages themselves every household invaded by the fever resorted to this river water for domestic purposes, whereas amongst a considerable number of their inhabitants using water from wells not a single case of enteric fever occurred. Between its rise from feeders in the Cleveland Hills and its approach to the villages in question the Rye is largely polluted. Thus, some five miles above Nunnington village it receives the crude sewage of the town of Helmsley; between Helmsley and Nunnington "town manure," including night soil from Leeds, is spread upon fields bordering on or draining towards the river; and some of the Nunnington villagers themselves add to its pollution by the deposit of similar filth on their fields, allotments, and gardens, on either side of the stream above the point at which they draw their drinking water. It was hardly necessary, under such circumstances, to inquire as to opportunities for the specific contamination of the river water by the material of enteric fever, but as a matter of fact evidence on this point was in no way lacking.

Incidentally it transpired during the course of this inquiry that the town of Malton had an altogether exceptional history

in so far as enteric fever and diarrhœa in fatal form are concerned. Situated on the Derwent, four miles below the confluence of the Rye with that river, Malton was found to derive its water supply from the Lady-well sunk to a depth of 14 feet in the middle Oolite rock, and occupying some low-lying land close to the river bank. Into this well river water gained access as soon as the Derwent rose above a given point; the amount of river water reaching the well varying from mere leakages through holes and crevices in the banks, to complete submersion of the Lady-well by the swollen stream. Gradually it had come to be noted that the outbreaks of fever and of diarrhœa followed on seasons of flood in the Derwent, a river which was referred to locally in 1890 as containing "the sewage of all the towns and "villages situated near the Rye and its numerous tributaries." Up to the date of Dr. Low's inspection in 1893 but little had been done to secure the Malton water supply against pollution.

Enteric Fever in Trent-side Villages.

In another report Dr. Bruce Low deals at considerable length with questions of water supply in relation to enteric fever in some sanitary areas abutting on the River Trent, and notably in certain villages where a number of the inhabitants habitually resort to the river for their drinking water. (*See* Appendix A., No. 9.) Almost from its source in Biddulph Moor, on the northern borders of Staffordshire, the Trent becomes polluted with sewage, and before reaching the town of Gainsborough, immediately below which the villages in question are situated, it receives directly, or by means of its tributaries, either the crude sewage of, or the effluent from sewage farms serving, an enormous population. The nearest towns above the villages in question are Newark and Gainsborough, and these alone add to the pollution of the river the sewage of a combined population of some 30,000. Contamination of the river is further brought about by reason of the habitual use, on agricultural land draining towards the Trent, of the town manure and night soil from some of the largest and most populous boroughs of South Yorkshire and the North Midlands. Having facts such as these in view, it had for some time been matter of local medical belief that the use of the Trent water for domestic purposes was associated with the occurrence of enteric fever. But representations made by the Board to the local authorities on the point were met by rejoinders such as are commonly formulated by parochial committees; rejoinders which went generally to deny the existence of any such risk as that implied, and in one instance, did not hesitate definitely to assert that "the Trent water is wholesome." It was under these circumstances that Dr. Low's inquiry was instituted, and evidence was at once forthcoming to show, not only that the river water was greatly polluted, but that some of its more obvious pollutions were of an altogether revolting character; other facts elicited went far to prove the specific pollution of the Trent by the bowel discharges of enteric fever patients from

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Newark and Gainsborough, as well as from other places. And when comparison was made, as regards enteric fever, between sets of villages in the Gainsborough rural district* grouped according to their water supply, it was found that of 192 attacks of that disease which could be heard of as having taken place in the district in the previous four and a half years, no fewer than 167, or 86·9 per cent., had occurred among a population under 6,000 living in villages, the main water supply of which was drawn from the River Trent, or from canals similarly polluted and communicating with the river; whereas only 25 cases, or 13 per cent. of the whole, had occurred in an aggregate population of over 13,000 in 41 villages using water from local pump wells. As bearing upon the quality of the pollutions liable to reach the Trent within the range of the river-side villages more specially in question, it may be mentioned that in the third quarter of 1893 some 50 or more cases of diarrhœa occurred in Owston Ferry, six of the attacks terminating fatally with choleraic symptoms. Owston Ferry fortunately lies lower down the Trent than most of the villages in which there is resort to the river water.

In connexion with this inquiry, Dr. Bruce Low elicited certain facts as to the existence of enteric fever in Newark, which are of interest, as indicating how large an amount of specifically diseased material reaches the Trent above the villages in the Gainsborough district. That fever was found to have been for some time past epidemic in Newark during the autumn months; and, apart from water supply, no sufficient cause for this could be found. Nearly half the population of the borough derived their water from local pump-wells which were, almost without exception, liable to pollution, and the remaining half used the public service, which was drawn from wells so situated and constructed as practically to supply Trent water. Of 297 cases of enteric fever which were known to have taken place in Newark during the three and a half years preceding Dr. Low's visit, 78·5 per cent. occurred amongst those who habitually consumed the river water, whereas only 21·5 per cent. took place amongst persons resorting to the polluted local wells. Newark has since provided itself with a constant supply of wholesome water from the New Red Sandstone. But the riverside villages below Gainsborough still resort to the Trent for their water.

In my report on Cholera in England during 1893, I pointed out that of the 64 localities in which cholera appeared in this country, the disease was limited in 42, or in nearly 66 per cent. of the whole, to one single attack; and this was the case, although, as regards the majority of the attacks, the disease must be looked upon as having been true cholera of the Asiatic

* Three of these villages have since been included in the newly-formed rural district of Misterton.

type, whether it be judged by its clinical symptoms, by the outcome of bacteriological research, or by the heavy rate of mortality which it occasioned. Such a result, altogether unique in the history of cholera, was, I believe, largely due to the improved sanitary circumstances of England. But it is certain that if, in the cases of public water-services I have been considering, the specific material which found access to the waters had been that of cholera, instead of enteric fever, our cholera history for 1893 would have been the record of even greater disaster brought about, in most of the cases, by deliberate neglect. Even as the matter stands, such instances of neglect remain a matter of reproach to our local sanitary administration.

Diphtheria in the Hinckley Urban and Rural Districts.

Amongst a number of inquiries instituted in connexion with the prevalence of diphtheria, one was of more than ordinary interest. I refer to Dr. Wheaton's report on an outbreak of that disease in the Hinckley urban and rural districts. (*See* Appendix A., No. 10.) The town of Hinckley lies on a soil which is cold and retentive of moisture, and it is so situated, at a considerable elevation sloping towards the River Anker, as to be exposed not only to bleak winds, but also to fogs and mists. No single diphtheria death had been registered amongst its population of some 9,700 during 1892, and during the first eight months of 1893 only one death, namely one in February, had been ascribed to that cause. But it was otherwise as autumn advanced; and on his arrival at Hinckley, towards the close of November 1893, Dr. Wheaton found that in the 11 weeks antecedent to that date 28 deaths had occurred from diphtheria, and that, so far as could be judged in a town where notification of infectious disease was not in operation, between 200 and 300 attacks of the disease had taken place. As a result of his investigation into the causes of this outbreak, Dr. Wheaton arrived at the conclusion that the water supply, the milk service, and the general sanitary circumstances could not be held to have had concern with it. In also eliminating the influence of sewers and drains, both as regards the origin and spread of the disease, he points out that the cases were scattered more or less over the whole town; that there was no special prevalence of the malady where house-drains communicated with defective sewers; and that houses in the vicinity of sewer ventilators were not especially invaded. Indeed, he found that "in the majority of the houses in which "diphtheria had appeared, the drains were in good condition." With regard, however, to the midden-privies, he inclines to the view that, by reason of their foul effluvia and the impregnation of the soil around them, these structures had an influence on the fatality of the diphtheria, and in conferring susceptibility to its infection. There was, however, no question that school attendance had conduced to the outbreak. The disease was apparently confined to the households of the working classes whose children attended the public elementary schools; 89 per cent. of the known attacks were in children under 14 years of age; and in

86 per cent. of the invaded households the first to be attacked was a child attending one or other of these schools. In the absence of a system of notification of infectious diseases, children continued to attend at school when a member of their family was suffering from diphtheria. On recovery they came back to school in clothes just as they had worn them during their illness; all attempt at isolation ceased on the disappearance of the more obvious symptoms; and no measures were adopted for the disinfection of the houses where the disease had occurred. The result of all this neglect was that there were abundant opportunities for the communication of the infection at school, and had it not been fo the care and vigilance of individual teachers the diffusion of the disease would probably have been on a wider scale.

The origin of this outbreak remains involved in much obscurity. The epidemic commenced in September, after the re-opening of the schools, and there had been a large fair in the town at the end of August, which might easily have facilitated the introduction of isolated attacks of specific throat-disease. It is also worthy of note that there had been a somewhat wide outbreak of measles in Hinckley in the latter half of 1892; the prevalence being very fatal and very largely associated with that which was locally described as "septic exudation on the fauces "and throat." As the year closed, scarlet fever set in as an epidemic; but the outbreak, which continued into the spring of 1893, is stated to have been mild and without notable throat complications. Cases of scarlet fever were more or less maintained up to mid-August, some of the later deaths being associated with severe and malignant sore-throat; and in the autumn, when the diphtheria set in, certain deaths came to be ascribed to "scarlet fever and diphtheria." When Dr. Wheaton visited the various elementary schools in Hinckley he found in all the schools a number of children suffering from sore-throat or nasal catarrh. The sore-throat involved such symptoms as swelling of the soft palate, tonsils, and fauces generally; with bright red injected patches, studded with enlarged projecting mucous follicles, and exhibiting not unfrequently a white film or pellicle which was devoid of the characters of the membrane of diphtheria. In many cases there was also a puffy swelling of the tissues of the neck. These affections were also found to be rife among the children of the town generally, and in groups of children amongst whom there was no suspicion of diphtheria. What the precise relation of these "sore-throats" was to the antecedent measles and scarlet fever on the one hand, and to the subsequent and concurrent diphtheria on the other hand, Dr. Wheaton was unable to decide. But he points out that the cases of throat ailment described were not followed by paralyses, and that, "contrary to what appeared to be the case with respect "to the prevalence of diphtheria," these affections of throat and nares were especially prevalent in houses the condition and surroundings of which were markedly unwholesome. If, as I have

ventured to suggest elsewhere, measles and scarlet fever, as also morbid states of the throat induced by exposure to unwholesome circumstances, tend to a condition of the fauces favourable to the reception and multiplication of the diphtheria contagium, the incidence of diphtheria amongst Hinckley school children exposed to such imported contagium is not difficult to explain. But, on the other hand, it is important to remember that in throat-ailments, the clinical indications of which have seemed limited to mere congestion of the fauces with enlargement of the tonsils and yellow patches in the tonsillar follicles, active diphtheria bacilli have often been obtained in the yellow exudation.*

Dr. Wheaton also discusses certain prevalences of diphtheria in the Hinckley rural district during 1893; and as regards a number of these the circumstances elicited corresponded in every essential particular with those recorded in connexion with the town outbreak. Thus, at Stony Stanton, 22 attacks of diphtheria, with 14 deaths, occurred. There was a special incidence on school children and on houses without any obvious sanitary defect, and there was widespread throat and nasal sickness which was in no way confined to households where cases of diphtheria had occurred. At Stoke Golding, where a limited but very fatal occurrence of diphtheria took place, there was also evidence of sore-throat and nasal discharge amongst the school children, but in this case the school was found to be defective in point of ventilation and otherwise. Only isolated cases of diphtheria could be heard of at Earl Shilton, Barwell, and Burbage, all three very populous villages; and in none of these villages could instances of any allied throat affection of the sort referred to be found amongst the school children.

During the summer of 1893 and the summer and autumn of the following year, outbreaks of a peculiar form of epidemic skin disease occurred in several of the Metropolitan Workhouse Infirmaries, notably those of Bethnal Green, City of London at Bow, St. Leonard's Shoreditch, St. Marylebone, and St. George-in-the-East. These outbreaks have been investigated and reported on by Dr. Copeman. (*See* Appendix A., No. 11.) This particular form of skin disease was first recognised in England in 1891, during which year cases had been observed in the wards of the Paddington and St. Marylebone Infirmaries; and the occurrence has been fully described by Dr. T. D. Savill, then Medical Superintendent of the Paddington Infirmary.† Previous outbreaks of apparently the same disease have, however, been recorded in other countries.

The disease bears some likeness both to pityriasis rubra and to acute general eczema, though for various reasons it cannot

* See, *e.g.*, Acute follicular diphtheria of the tonsils. Deutsche Medizinal-Zeitung, November 22nd, 1894.

† On an Epidemic Skin Disease, by Thomas D. Savill, M.D.Lond. H. K. Lewis, Gower Street, London, W.C. 1892.

well be classed under either of these terms. Provisionally, and in the absence of exact knowledge as to its etiology and pathology, the term "Epidemic Skin Disease" would appear to be the most convenient one under which to describe the affection. The various symptoms observed during the progress of this malady, the presence or absence of certain of which give rise to more or less distinct types of the disease, such as the "moist" and the "dry" forms, have been described by Dr. Savill in the accounts which he has published concerning the epidemic observed by him in 1891. His description may for the most part be taken as applicable to the cases observed during the outbreaks reported on by Dr. Copeman, with the exception that in many instances a distinct rise of body temperature, often synchronous with appearance of the rash, has been noted in the more recent prevalences. Temperature charts illustrative of this point are appended to Dr. Copeman's report. In those instances more particularly in which a number of persons were continuously under medical observation antecedent to attack by the disease, a prodromal stage was noticed during which there was general loss of appetite, accompanied by malaise and sensation of nausea, together with actual vomiting in some cases. This was witnessed, for instance, in the sick wards of the infirmary at Bethnal Green during the third week of April 1893, although it was not noticeable in the workhouse proper, nor in the "infirm" wards of that building. About a fortnight later a number of the infirmary patients in question presented symptoms of the epidemic skin disease. There appears, however, reason for believing that the disease, whether "moist" or "dry," does not always exhibit precisely the same order of symptoms. Even the rash on the skin is not an absolutely essential concomitant of the general constitutional disturbance by which the malady is characterised.

The duration of the disease has been very variable, and relapses at intervals of a few days or weeks have been frequent. During convalescence loss of epidermal structures has been common, the hair of the scalp having been completely lost in some cases, and the skin, especially that of the hands and feet, having been shed in large patches. Complete "casts" of the foot or hand have occasionally been obtained. The fatality rate in those cases in which death may be regarded as having been directly dependent on the epidemic malady has ranged from about 5 to 12 per cent. of the attacks. The fatal attacks have mostly occurred amongst the aged, and they have commonly been due to exhaustion; but in a small proportion of cases death has been preceded by albuminuria and uræmic coma.

With reference to the etiology of this disease the facts noted during the first outbreak which came under Dr. Copeman's observation, that, namely, which occurred at Bethnal Green, were, broadly, as follows:—The disease was mainly

confined to elderly persons of both sexes; such persons being for the most part inmates of the infirmary on account of chronic ill-health. The sanitary circumstances of the institutions affected could not be regarded as having had to do with the causation of the disease; but there are grounds for believing that the distribution of the malady and its severity were, in some cases, increased by the obviously defective conditions of cleanliness, ventilation, and nursing, to which some of the sick were subjected. Amongst the class of inmates affected, only those were attacked who happened at the time to be on a dietary which included a certain daily amount of milk; the amount ranging from half a pint to as much as three pints in exceptional instances. Patients in the "infirm" wards of the workhouse proper altogether escaped infection; and this, although they occupied buildings which closely adjoined and were aërially one with the infirmary wards. Indeed, they appeared to be, with the one exception of not having milk as part of their diet, in all respects similarly circumstanced to the inmates of the infirmary.

In the more recent outbreak at the infirmary of St. George-in-the-East, the first cases of the disease known to have occurred came under observation about a week subsequent to a change in the milk service of the institution. So also, on the expiration of about an equal period of time from the date of the substitution of preserved milk for the contract supply, a distinct diminution in the number of fresh attacks at once set in. That a marked rise and subsequent fall in the number of persons attacked should have corresponded, as it is shown to have done, with the commencing use and withdrawal repectively of a particular milk service can hardly be explained except on the theory that some condition of the milk service had causal relationship with the disease. The exact nature of this condition remains, thus far, undetermined; but it would seem to be for the most part a concomitant of a distinctly inferior quality of the contract milk. In this connexion it is of interest also to observe that in each of the outbreaks investigated by Dr. Copeman, and in which there appeared reason for suspecting such causal relationship, the contract for the milk supply was in the hands of the same contractor.*

On the other hand, in certain other institutions, amongst which the St. Marylebone Infirmary may be specially mentioned, there was found no reason for suspecting implication of the milk supply. In these institutions the disease has commonly been of a decidedly mild character. Moreover, the cases which arose did not occur in the form of a definite outbreak, the attacks being scattered over considerable periods of time. Many of the cases,

* Whilst this report is passing through the press, I learn that the same disease has occurred amongst the inmates of another workhouse establishment, and that the occurrence has coincided in point of time with a change in the milk service: the new supply having been provided by the same contractor as the one above referred to.

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especially the earlier ones, were also received into these infirmaries from outside, as, for instance, from workhouses, from Salvation Army Shelters, and from private dwellings; the latter being for the most part of the poorest class. Probably some of the cases in question were due to personal infection, the disease under consideration being apparently of a more or less infectious nature.

The pathology of this epidemic skin disease has been studied for the Board both by Dr. Copeman and, more fully, by Dr. Andrewes. Amongst other things, search has been made with a view of ascertaining whether the causation of the disease might reasonably be attributed to some specific organism; but thus far the search has been without success. An organism believed to be thus related to the disease has indeed been described by previous observers, but Drs. Copeman and Andrewes agree in regarding the organism in question, and which has been found in the exudation and skin flakes obtained from cases of this disease, as identical with a staphylococcus which can be obtained from the superficial layers of healthy skin. This "epidemic skin disease" evidently calls for further study, as opportunity may arise.

Returns of Notified Infectious Diseases.

In continuation of the practice commenced in my last annual report, I have set out in tabular form for each quarter of 1893 a statement of the number of notified cases of small-pox, scarlet-fever, diphtheria, and fever, as also of the number of deaths registered during the same periods from these several diseases. The tabulation applies to 81 districts, for which the data necessary for comparison of the rates of attack and of death were available.

By the aid of the Registrar-General, I am now, for the first time, further able to supply material for the same comparison, week by week, as well as quarterly and for the whole year, in the case of the 42 sanitary areas, including the port of London, which are comprised within the administrative county of London. In the case of these metropolitan returns, the various continued fevers are dealt with separately; and correction has been made for London as a whole as regards those instances in which there has been dual notification of the same attack. These several returns will be found in Appendix A, No. 12 and 12 (a).

Lead Poisoning by Moorland Waters.

For some years past the Board have from time to time had brought under their notice, in the reports of medical officers of health and otherwise, the fact that, at intervals, the water supplies of some of our large towns have been dissolving lead and producing lead poisoning on a somewhat wide scale amongst the water consumers. The occurrences in question were understood to be practically limited to towns and districts receiving soft moorland water. During the year 1885 the Sheffield water came suddenly to possess the power of vigorously dissolving the lead of the delivery pipes, with the result that the water was

found to be producing plumbism amongst a large number of the inhabitants of that town This Sheffield occurrence was made the subject of a report by Dr. Sinclair White, then Medical Officer of Health to the borough. In this report attention was drawn to the different behaviour of a water in respect of its ability to dissolve lead according as it came from one or other gathering ground, or as it represented the aggregate of water from different sources. And, not only was this diversity manifest in waters owning different local origins, but variability was also observed with alterations of temperature and other physical conditions. All Sheffield water-samples that dissolved lead were found to afford acid reaction; and Dr. Sinclair White spent much time and labour in the attempt to ascertain the source of free acid in these waters. But no definite determination was then made as to any single chemical condition the presence or absence of which stood in direct co-relation with the variations in the lead dissolving power of a water.

In his report on the proceedings of the Medical Department for 1887,* Sir George Buchanan submitted a paper by Mr. W. H. Power in which the latter, after study of the subject generally, and of the facts recorded respecting the Sheffield experience set out the considerations to be borne in mind in making further investigation of the conditions under which moorland waters at times acquire this power of dissolving lead. In concluding this paper Mr. Power, after summarising the observations arising out of the inquiries made at Sheffield, wrote as follows:—"Phenomena such as these if observed in the "biological laboratory in relation with the life processes of one "or another microphyte would not be difficult of comprehension. "The suggestion of them, therefore, in this connexion will have "raised suspicion whether the inscrutable behaviour of soft "moorland waters in regard of the plumbo-solvent ability may "not be related to the agency, direct or indirect, of low forms of "organic life. So that the question would seem to be arising "whether chemistry, which by itself has failed to afford satis-"factory explanation of the plumbo-solvency of moorland water, "may not get advantage by association of biology in the "problem."

Following on this, certain laboratory studies were made under the supervision of the Medical Department, of acid waters obtained from Sheffield, which were possessed of the power of dissolving lead, and of the organised forms contained in them; but it soon became manifest that no laboratory studies could supersede investigation of the circumstances of the origin of these waters and of the conditions under which they acquired their power of taking up lead. In 1890, the sanction of the Board was obtained to an inquiry into this subject by the Medical Department, such

* Supplement by the Medical Officer to the 17th Annual Report of the Local Government Board. [C.—5526.-I.] 1888.

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inquiry to include not only chemical and bacteriological study of the circumstances which might give to these waters the power of dissolving lead, but also simultaneous investigation at the various gathering grounds of the origin and characters of the waters having plumbo-solvent quality.

The interim report by Mr. W. H. Power contained in Appendix A, No. 13, gives some account of the progress, thus far, of this inquiry. Observations were in the first instance confined to the gathering ground at Burnmoor near Settle in Yorkshire, water from different parts of which were for some eighteen months examined week by week as to their physical, chemical, and bacteriological features; the results being recorded along with concurrent meteorological and other conditions, and compared with the ability of the same water week by week to take lead into solution. With the latter only one chemical condition has been found generally parallel, while none of the other conditions observed have been at all parallel. This is the amount of acidity of the water. And a similar correspondence was found to exist when the experience of Burnmoor was applied to other gathering grounds. For although the amount of lead taken up by one water as compared with another was not always found to be in direct proportion to the relative acidities of the two, yet for a particular water, variations in its lead dissolving property were always associated with corresponding variations in the amount of its acid.

The problems of plumbo-solvency of a moorland water thus came to be in large measure problems of the particular acidity connected with it, and accordingly experiments were undertaken to determine the nature of this acidity and its source. Having ascertained that a moorland water has not in itself any power of developing or increasing in acidity, it remained to be discovered where in its moorland history the water acquired its acid properties. It was soon ascertained that it was from the peat that the water derived this quality, and the question next arose whether the acidity of the water was due to merely chemical and physical re-action of the water and the peat, or to active organic life in the peat itself. The answer is indicated in the experiments so far reported on. They show that while neither moorland water nor a sterile decoction of peat can of itself develop acidity, the addition to either of a minimal amount of moist peat soil will cause bacterial growth in it with increasing development of acid re-action and ability to dissolve lead. And they have further indicated two species of microbes which alone, among the many kinds of micro-organisms found in the samples of peat examined, have the power of producing acidity when added to a sterile decoction of peat.

At this stage, then, Mr. Power's forecast of 1887 would seem to be borne out as the result of the labours of the experts who have been engaged in this inquiry. The investigation is, how-

ever, by no means completed, and it is being continued throughout the current year.

II.—*CHOLERA PREVALENCES.*

RECRUDESCENCE OF CHOLERA IN GERMANY IN 1892-93.

In continuation of the account published in my last Annual Report of the epidemic of cholera in Europe during 1892, I would draw attention to a paper contained in Appendix A., No. 14, in which Dr. Barry has recorded the history of a recrudescence of that disease in Germany during the winter of 1892–93. This recrudescence involved three outbreaks. The first was in Hamburg, where the disease recurred in December 1892, and continued into the early part of the following year. The progress of this outbreak, which led to 64 attacks and 17 deaths, is shown to have been largely concerned with opportunities for personal infection, but there were groups of attacks in which the consumption of water, which had been contaminated by cholera discharges, must be regarded as having served to convey the disease. The second outbreak took place in Altona. The public water-supply of this town was described in my last report; it is derived from the Elbe at a point below that at which this river receives the sewage of Hamburg; and it is delivered to the population after a process of filtration through sand; a process which had formerly been deemed so far to remove from it the micro-organisms, benign or pathogenic, which it contains as to make the water a wholesome one for domestic purposes. This winter prevalence in Altona commenced about the time when the Hamburg outbreak just referred to was at its height, and not only so, but it was found that it had coincided with the ascertained presence of cholera bacilli in the Elbe itself, as well as in the water pumped up from the river to the Altona filters, and also with disturbances of those filters that seriously curtailed their function of removing micro-organisms from the water passing through them. Disturbances of one and another sort cannot be altogether avoided, and the story from Altona goes far to discount many of the claims that have recently been put forward as to the results that can be expected to follow the sand filtration of public water-supplies. One localised group of cholera attacks in Altona is referred to by Dr. Barry in some detail; the occurrence having been associated with the use of water from a well which had been accidentally subjected to contamination by infective material. In all, there occurred in Altona 45 cases and 24 deaths. The third outbreak in Germany occurred at the lunatic asylum at Nietleben, near Halle. Some account of this occurrence has already been given —in a paper "On Water Filtration and Cholera," by Professor Koch—in my last Annual Report. More complete details as to the Nietleben outbreak are given in Dr. Barry's appended paper, from which it will be seen that cholera infection, which was in all probability derived from Hamburg, was conveyed by means

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of sewage over the frozen surface of the asylum sewage farm in such a manner as to reach the water supply of the institution. As in most cholera outbreaks due to pollution of a general water-supply, a definite explosion of cholera ensued; 122 attacks and 52 deaths taking place in a community of 991 persons.

These occurrences of cholera in Germany may be regarded as mainly having had concern with 1892. With respect to European cholera during the following year, I have, as already stated, submitted to you a separate report, entitled: "Cholera in England during 1893"; but, owing to the fact that I have not yet been able to procure all the necessary official reports as to the prevalence of that disease in other States of Europe, I propose to defer the detailed record of the prevalance of cholera during 1893 in foreign countries until my next Annual Report. I therefore confine myself, for the moment, to a very general summary of such occurrences.

CHOLERA IN EUROPEAN AND OTHER COUNTRIES DURING 1893.

During the winter months 1892–93 cholera became for the time all but extinct in the greater number of the countries invaded during the summer and autumn of 1892. It persisted, however, to some extent, in European Russia, especially in Podolia and the Ukraine; in Persia; in certain western departments of France; and in the province of Yemen in Arabia. This continuance of cholera had, in Arabia, very far-reaching consequences, for to it must be attributed the epidemic which during 1893 attacked the Mecca pilgrims, causing amongst them, at the lowest estimate, some 50,000 deaths. By the aid of returning pilgrims the disease was carried into Asia Minor, Turkey in Europe, Tripoli, and Morocco. As the summer advanced cholera became more widely diffused in Russia, although, unlike the experience of 1892, the western provinces suffered most; the mortality in the eastern provinces of European Russia, in the Caucasus, and in Asiatic Russia being trifling in comparison with that of the previous year. In France cholera was reported from several departments, chiefly from those situated in the west and south. Recrudescences also occurred in Holland, Belgium, and Germany, but in none of these instances did any serious epidemic ensue. During June and July of 1893 Hungary became widely invaded, and the disease spread with considerable rapidity into Austria and Bosnia. Roumania, which had remained free during 1892, was also the scene of a cholera outbreak. The disease became seriously prevalent in certain parts of Italy, where it led to several hundred deaths. Spain was also to some extent invaded, and the disease extended to Tunis and Algeria in North Africa, to Senegambia in West Africa, and to the Canary Islands. Cases were also conveyed by ship to the United States and Brazil in the Western Hemisphere. In Western Asia, where the disease was probably related to a previous diffusion in Persia, a severe outbreak in the villayets of Bassorah and Baghdad led to upwards of 7,400 deaths.

§ English Cholera Administration.

Medical Officer's Report. — Cholera Survey.

Following on the rapid inspection of port and riparian districts which was instituted as cholera approached Western Europe in 1892, a much more complete Cholera Survey of port, riparian, and inland sanitary districts was organised early in 1893. All the 60 port sanitary districts of England and Wales, as also 35 urban riparian and nine rural riparian districts, were subjected to detailed inspection during the year by the Board's Medical Inspectors. In a similar way 88 inland urban, and 14 inland rural districts were inspected. Indeed, a considerable number of the Board's Medical Inspectors were engaged in this work throughout the year. The general supervision of this Survey was deputed to Dr. Barry, who has prepared a brief summary of the work done, together with two charts showing the localisation of the districts inspected. (*See* Appendix A., No. 15.) I propose to submit to the Board, in a separate volume, the results of the Cholera Survey of English ports, and I defer until my next annual report an account of the proceedings taken as regards inland sanitary districts, the survey of which was continued throughout 1894. Under these circumstances I would only observe, on this occasion, that much valuable work was effected as the result of the Survey, by way of securing local organisation and arrangements better fitted than heretofore to meet the risk of imported cholera, and that the importance of this work often became evident in connexion with those local experiences of cholera in this country during 1893, which have already been reported on.

Other Cholera Precautions.

Having regard to the previous history of cholera epidemics in Europe, and to the movements of the disease in the early part of 1893, I submitted to the Board on June 8th of that year a Memorandum pointing out that this country would probably run even greater danger from imported cholera during the then ensuing summer and autumn than had been the case during the serious epidemic of 1892. That Memorandum (*see* Appendix A., No. 16) was issued by the Board with a view of urging sanitary authorities to make such arrangements in advance as would enable them to prevent extension of any cholera that might be imported into their districts. The subsequent history of cholera in this country during the latter part of 1893 showed that the warning was fully justified. A special circular was also issued by the Board, on 22nd June 1893, to the sanitary authorities in the Metropolis, requesting them to take into early consideration the question of their being prepared in advance to meet any emergency that might arise in the course of the ensuing autumn (*see* Appendix A., No. 17.)

Cholera and Rag Importation.

During the year 1893 the attitude of the Board with regard to the importation of rags from countries where cholera was known to prevail underwent an important modification.

The imposition of restrictions on the importation of rags by the Local Government Board dates from 1883. In that year cholera became epidemic in Egypt, and Professor Koch, of

Berlin, studying the etiology of the disease in that country, announced his discovery of the cholera bacillus, and also stated that this micro-organism, according to his experiments, multiplied with great rapidity on moist linen. With a view of obviating danger to this country from imported rags, it was at first deemed desirable to give to the Medical Officer of Health at each port of arrival the duty of indicating the precautions—such as disinfection or destruction—that were in his opinion necessary in the case of rags from Egypt. But, whilst provisionally concurring in this action, my late predecessor, Sir George Buchanan, took occasion to state in a Memorandum on the subject, addressed to the Board on the 1st of August 1883: "It is not known that, as a matter of fact, cholera has been "ever introduced into England by rags." The discretionary power vested in the Medical Officer of Health under the Order of 1883 was ultimately found to give rise to diversity of practice in different ports, and thus to cause much inconvenience to importers and traders. Hence in subsequent years all Orders as to Rags issued by the Board imposed uniform restrictions.

During the proceedings of the International Sanitary Conference of Dresden, which were held in March and April 1893, and to which I shall again refer, the question as to the need for imposing restrictions on rags was on several occasions discussed. The different medical delegates were asked if any of them could give an instance of the communication of cholera by means of rags. Several were of opinion that linen, bedding, and clothing that had been recently soiled by cholera discharges had been the means of communicating the infection; but no one could record an instance in which rags, as an article of commerce, had served as a vehicle of cholera infection. On the contrary, the evidence given went to indicate that, in view of the circumstances of rag collection, and of the long interval—many months, and at times even years—which elapses between the date at which rags are collected and that at which they are ultimately exported in bales as merchandise, it was more than doubtful whether any cholera infection, if originally present in the rags, could survive under the circumstances. And it was further held that if the importation of rags was to be prohibited, the prohibition, to be consistent, ought to be maintained for a long period—even years—after the cessation of the epidemic which had led to the prohibition. Professor Koch, speaking on the subject, declared that in no single instance had there been, to his knowledge, an authenticated case of the transmission of cholera by means of rags of commerce. This view received the support of Professor Brouardel and Professor Proust of Paris, as also of the leading medical delegates of Europe. I, too, explained that it was in accordance with English experience.

The result of the debates at Dresden was that the following resolution was come to by the Conference, and was subsequently embodied in the Convention:—

"The only susceptible goods or merchandise the importation of which may be prohibited are:—

"1. Body linen, rags ('hardes') and clothes which have been worn (clothing—'effets à usage'); used bedding. When these goods are transported as luggage or on change of house (household removals) they are subject to special regulations.

"2. Rags ('chiffons et drilles').

"The following may not be prohibited: (*a*) rags compressed by hydraulic force, transported as wholesale merchandise in bales surrounded by iron bands, and with marks and numbers showing their origin, and accepted as such by the authorities of the country of destination; (*b*) clean clippings ('déchets neufs') coming directly from spinning, weaving, making up, or bleaching establishments; artificial wool ('Kunstwolle' 'shoddy'), and fresh paper shavings.

"The transit of susceptible merchandise or goods, so packed that they cannot be handled on the way, shall not be prohibited."

The signature of the Convention on behalf of Her Majesty's Government led to a reconsideration of the Orders as to Rags in force in England, and it was decided to revoke the existing regulations and bring them into conformity with the conclusions arrived at in Dresden. This was done by the issue of a new Order on 5th August 1893, supplemented by a further Order of 13th September 1893, whereby "Rags packed in bales and "imported as merchandise," were defined. These Orders will be found in Appendix A., Nos. 18 and 19, and they practically free from restriction all rags of merchandise imported into this country.

Conference with the Sanitary Committee of the States of Jersey.

On the 17th of March 1893 the Sanitary Committee of the States of Jersey addressed a letter to the Board, asking whether they would consent to send an inspector to the Island of Jersey for the purpose of advising the States as to the best means of preventing the introduction of cholera into the island. Prior to their making this request, the Sanitary Committee had recommended the States of Jersey to have recourse to quarantine; but this proposal had been rejected by the States. The Sanitary Committee of the States, in preferring their request to the Board, asked that, if it were complied with, the conference should take place before the second week in April, because of anticipation that the annual influx into Jersey of Breton labourers, employed in the potato harvest, would commence about that date. Dr. Theodore Thomson was accordingly instructed to proceed to Jersey. He arrived in the island on the 4th of April, and, having made inquiries such as to enable him to advise the Sanitary Committee of the States, he conferred with that body on April 6th as to the measures proper to be taken by them with a view to dealing with cholera. Dr. Thomson, at this conference, advised:—the adoption of a system of medical inspection of vessels coming to Jersey, with supervision for a few days of all persons arriving in the island by whom cholera could be thought of as liable to be introduced; the provision of proper arrangements for the isolation of any cholera sick; a sanitary survey of the whole island, in which especial attention should be given to the various water-supplies, and

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notably to that for St. Helier; and the division of the island into districts to be suitably organised with a view of dealing with any imported cholera.

A Memorandum embodying recommendations as to the detailed action that should be taken with a view to these measures was left with the Sanitary Committee of the States, who expressed to the Board their high appreciation of the services which had been rendered by Dr. Thomson.

III.—*INTERNATIONAL SANITARY CONFERENCE OF DRESDEN.*

INTERNATIONAL SANITARY CONFERENCE OF DRESDEN.

On the 11th March 1893 the International Sanitary Conference of Dresden, to which incidental reference has already been made, was opened; the countries represented at it being—Germany, Austria-Hungary, Belgium, Denmark, Spain, France, Great Britain, Greece, Italy, Luxembourg, Montenegro, the Netherlands, Portugal, Roumania, Russia, Servia, Sweden and Norway, Switzerland, and Turkey. The British delegation consisted of Mr. George Strachey, Her Majesty's Minister Resident at Dresden and myself, as delegates, and Mr. H Farnall, C.M.G., of the Foreign Office, as assistant delegate. The Conclusions arrived at by the Conference may be regarded as supplementing those embodied in the Venice Convention of 1892. The Venice conclusions aimed at preventing the entrance of cholera into Europe by the Red Sea and the Suez Canal; those adopted at Dresden sought to control cholera, both by land and sea, in case it should have made its way into Europe.

The Dresden regulations define a maximum beyond which restrictions shall not extend, and a minimum which must be imposed by all parties to the Convention. As regards both land and maritime traffic the Dresden conclusions approach nearer to the English standard than any arrived at on the occasion of any similar gathering; and with two exceptions the minimum of restrictions made obligatory coincided with the regulations which had long been in force in England. The first of these related to the importation of rags as to which, as already stated, the Board have since adopted the rules laid down by the Dresden Conference. The second had to do with the detention under "observation" of healthy persons landing from infected vessels. The regulation dealing with this subject was only assented to by the British delegation under the reserve that "observation" would, in the case of England, be limited to a supervision by the local sanitary authority of such passengers for a few days in their own homes. The report presented by the British delegates to the Earl of Rosebery, then Foreign Minister, will be found in Appendix A., No. 20; it gives a general account of the proceedings of the Conference and it only remains for me to add that the Convention was signed by Great Britain, Germany, Austria-Hungary, Belgium, France, Italy, Lichtenstein, Luxembourg, the Netherlands, Russia, Servia, and Switzerland; and that it is now in

operation. Together with the two other British delegates I had the honour of being appointed Her Majesty's Plenipotentiary for the purposes of the signature of the Convention.

IV.—*AUXILIARY SCIENTIFIC INVESTIGATIONS.*

Etiology of Enteric Fever.

The "Typhoid Bacillus," though it has come to be regarded as in all probability the essential cause of enteric fever, has never yet been experimentally proved capable of inducing that disease. Rodents inoculated, whether subcutaneously or intraperitoneally, with this bacillus, do indeed suffer fatal illness, but, as Dr. Klein has pointed out in the appendix to my report for 1892–93, the malady thus induced by him in the guinea-pig, is *not* of specific nature; it is, moreover, just as easily produced by injection of other and various microbes. In 1893–94, he has (Appendix B., No. 1) further tested the ability of the typhoid bacillus to produce enteric fever, using for his purposes monkeys and calves.

Dr. Klein's experiments on monkeys comprised two series; feeding these animals with the typhoid bacillus, and inoculating the microbe into their groins.

As to *feeding*, two monkeys were made to swallow, on several successive days, milk and bread to which had been added broth culture of the typhoid bacillus derived from the spleen of a person who had died of enteric fever. Neither of these monkeys suffered any illness whatever, and when they were killed two or three weeks later, no pathological lesions were found in them. Moreover, attempt to recover, by culture, the typhoid bacillus from their heart-blood and spleens failed in both instances.

As regards his *inoculation* experiments, however, Dr. Klein obtained results that were less unequivocally negative. In all, eight monkeys were included in this series, each of them being inoculated in considerable amount with gelatine culture of the bacillus derived, as before, from the spleen of enteric fever. Some, but not all, of these eight monkeys exhibited rise of temperature, and certain of them suffered more or less from loss of appetite and from diarrhœa; but none of them displayed any symptom that could be definitely attributed to enteric fever. Of the eight, two (which had been accidentally inoculated with a culture containing the streptococcus of erysipelas, as well as the typhoid bacillus) died on the 6th and 16th day respectively, and other five were killed at intervals varying between 11 and 16 days from the date of their inoculation. Examined post mortem, none showed any intestinal or other lesion parallel to those of enteric fever, except that in certain of them there was enlargement of the spleen, and in one enlargement of the mesenteric glands also. And bacteriologically, the evidence proved, in the main, negative; cultivation of the mesenteric gland-juice and of the heart-blood in no instance yielded the

typhoid bacillus, nor was this organism found, after death, in the intestinal contents of any one of these monkeys. As regards the spleen alone—and this only in those cases (three) in which that organ appeared enlarged—was there suggestion of positive bacteriological result. Thus, the spleen of one monkey (dead on the 6th day of mixed infection), yielded the typhoid bacillus in abundance and in pure culture; from that of another was obtained bacillus coli; while in a third instance, the monkey's enlarged spleen yielded a nondescript bacillus, exhibiting characters pertaining some of them to bacillus coli others to the typhoid bacillus.

Whatever may be the interpretation of the above results as regards the monkey, they were too indefinite for Dr. Klein's purpose, and he proceeded next to inoculation of calves. Four calves were injected by him subcutaneously in their groins with broth culture of the typhoid bacillus derived from the spleen of enteric fever. In none was there observed any rise of temperature or other symptom of illness; but in every one there occurred within three to four days of inoculation distinct enlargement of the inguinal lymphatic glands on the side operated on, which enlargement persisted until the calves were killed 10 days to a fortnight from the date of experiment Post mortem, all the viscera were found normal; the four calves presented absolutely no lesion, except that in each instance the lymph glands of the region inoculated were enlarged and juicy. Bacteriologically the heart blood and spleen failed always on cultivation to yield micro-organisms, but the juice of the enlarged inguinal glands contained without exception the typhoid bacillus in abundance. The indication thus obtained that the tissues of the bovine animal can serve as a multiplying ground for the typhoid bacillus obviously deserves to be followed up by further experiments.

Other study by Dr. Klein in 1893-94 of the etiology of enteric fever has had to do with the stability, as separate species, of the typhoid bacillus and bacillus coli, in culture under laboratory conditions and in the process of transference from animal body to animal body. On the one hand bacilli of both sorts derived in each instance from *human sources*, were tested by him as to their vitality, and as to retention of their differential characters, in waters of various composition or quality; and on the other hand, the two sorts of bacillus obtained from outside the human body, namely, from excrementally polluted public *water supplies*, were transferred again and again from subculture to subculture, and were passed from peritoneum to peritoneum in separate series of guinea-pigs But the result was always uniform. Whatever the source of the one and the other bacillus, and whatever the experimental conditions in the laboratory or in the animal body to which it was exposed, each retained unimpaired the differential features that characterised it at the outset. Incidentally it appeared in the course of these experiments that the persistence in a water medium both of the

typhoid bacillus and of bacillus coli, is largely governed by the chemical constitution of the water of experiment. The fact is noteworthy, and in this connexion these microbes are deserving of further study.

In his former report (1892–93) on protective inoculations, Dr. Klein insisted on the need for distinction between the protoplasm and the metabolic products of the microbe of a given disease. It is not, he pointed out, yet known in regard of many specific infectious diseases, how far the manifestations of the malady are due to the mere presence in the infected animal of a particular bacterium *per se*, or to the metabolic products which result from the life-processes of the microbe; and further, he urged, differentiation of "protoplasm" and of "product" is the more called for if, for the purpose of rendering the animal body proof against the virus of a disease, trustworthy materials are to be derived from the microbe associated therewith. Dr. Klein had been then working with a number of dissimilar microbes which each and all of them, when their intracellular substance was introduced into guinea-pigs, produced in these animals one and the same malady; and further, guinea-pigs thus made ill by inoculation with the intracellular poison of any one of his microbes were found by him to be protected against infection by any of the others. Dr. Klein inferred from this that the intracellular substances of all his microbes contained (physiologically) one and the same poison, and that the poison thus found common to all of them must needs be *non-specific*, and in no sense therefore related to the manifestation of the different diseases certain of these microbes have been found able to induce.

The particular microbes with which he had been experimenting included not only the typhoid fever bacillus but also Koch's cholera vibrio, and in so far as results of the above sort obtained by him in regard of the latter microbe seemed to call in question the protective value of those anti-cholera inoculations of the human subject which were being practised abroad, Dr. Klein's inferences appeared of some considerable importance. Koch's vibrio, however, as also the typhoid fever bacillus and the other microbes with which Dr. Klein had been working, belong to a group of micro-organisms having, whatever their virulence for the human subject, but feeble pathogenicity for rodents; large doses, whether of their protoplasm or of their metabolic products, being requisite for production of physiological effect in the guinea-pig. And accordingly it seemed desirable that judgment should at least be suspended until Dr. Klein's experimental observations of intracellular poisons had been extended to microbes which not only are pathogenic to man but also are virulent in small doses to rodents.

Among the microbes studied in the latter sense in 1893–94 by Dr. Klein (Appendix B., No. 2), the bacillus of anthrax and the diphtheria bacillus sufficiently well represent bacteria

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pathogenic alike to the human subject and to the guinea-pig: And as to these Dr. Klein has some interesting facts to record. Bacillus anthracis and bacillus diphtheriæ were tested by him as to the presence within their protoplasm of any (intracellular) poison; whether, that is, the protoplasm of the one and the other microbe is capable of inducing in guinea-pigs any definite illness. Further, guinea pigs that had been thus injected with the protoplasm, and protoplasm only, of the anthrax bacillus or of bacillus diphtheriæ, were tested by him as to their immunity against, or tolerance of, injection with the virus of anthrax and diphtheria respectively. And Dr. Klein found that neither the one nor the other bacillus included in its protoplasm any chemical poison; that these bacilli, apart from their metabolic products, exercised no physiological effect whatever when injected into guinea-pigs; and that guinea-pigs thus dealt with obtained thereby no immunity whatever against anthrax or against diphtheria.

These results of Dr. Klein's further study of protective inoculations are of a sort to strengthen his doubts as to the ability of the protoplasm of a given microbe to inhibit, when antecedently injected into the human subject, the physiological activities of the same microbe *quâ* its metabolic products. From Dr. Klein's point of view, therefore, the more matured experience of India in the matter of the anti-cholera inoculations there being practised, will be looked for with particular interest.

ETIOLOGY OF CANCER.

Concurrently with increase of late years in the mortality referred to Cancer, special attention has, by aid of improved methods of staining and preparing specimens, been directed to the histology of this disease, and thus it has come about that not a few observers are affirming the presence of parasites in cancerous tissue. Question has therefore arisen as to whether, in the interests of public health, cancer should not be regarded as coming within the domain of preventive, rather than of curative medicine, and accordingly preliminary investigation has been undertaken of the claim of Cancer to be regarded as a parasitic disease.

Dr. Klein, in a paper in this volume (Appendix B., No. 3) on "Psorosperms in their Relation to the Etiology of Cancer," enters on a critical examination of epithelial cancer from this point of view, and his paper is perhaps the more deserving of attention since he finds reason for abstaining from formulating any definite conclusion on the subject. He points out that as an essential condition of the problem to be solved, it is necessary to define, in regard of malignant growths in epithelial structures, what morphological appearances are peculiar to cancerous epithelium *but to no other epithelial tissue in health or disease;* and he goes on to institute strict comparison of the morphological elements of epithelial structures under various conditions normal and abnormal. As a result he deals with a number of appearances which, though they have been adduced as evidence of the presence in cancer of parasites or spores of

parasites, are nevertheless to be found in epithelial structures in circumstances where cancer is altogether out of question. In this way Dr. Klein eliminates from consideration a number of alleged parasitic forms as not necessarily foreign to the tissues of the animal body, and finally retains one only, namely, an amœba, described and termed rophalocephalus carcinomatosus by Korotneff, as unquestionably parasitic in nature. This amœba, however, though diligently sought for by Dr. Klein in many cancers, has not been found by him in more than a single instance, and he hesitates, therefore, to accept the organism as having definite relation to cancerous disease.

BACTERIOLOGY OF VACCINE LYMPH.

Certain bacilli obtained by Dr. Klein indifferently from calf lymph, from human lymph, and from small-pox matter, were reported by him in 1892–93 as possessing identical morphological characters. But inasmuch as these bacilli refused to grow and multiply on or in any of the artificial culture media employed by him to that end, Dr. Klein had not been able to ascertain in what way they differed—if, indeed, they differed at all—one from another, or to determine whether these microbes were dead or living.

In 1893–94, he has engaged in further attempt (Appendix B., No. 4), at differentiation of these bacilli; using lymph taken from the vesicles of the calf at intervals varying between 72 and 112 hours after vaccination of that animal, and employing as culture media certain nutritive materials not previously adopted by him. In all, his further attempts to grow the bacilli of calf lymph extended to above 100 culture experiments, but in no single instance did growth result; all his cultures proved sterile. He next sought to cultivate these bacilli in the living subcutaneous tissues of guinea pigs and of calves. But here, again, he met with no success; and, for the present, the question as to the identity of the bacilli found by him alike in vaccine lymph and in small-pox matter, must remain undetermined.

CHEMICAL PATHOLOGY OF TETANUS.

Dr. Sidney Martin's investigation of the chemical pathology of tetanus, referred to in my last report as then in progress, has advanced on lines indicated by his previous researches respecting anthrax and diphtheria. The preliminary report now submitted by him (Appendix B., No. 5), gives account of his chemical examination of the tissues of persons dead of tetanus, of the albumoses and acid organic substances thus obtained by him from their blood and from their spleens, and of the physiological effect of these upon rodents. As yet, Dr. Martin has not ascertained whether similar albumoses and acid organic bodies are obtainable from animals in which tetanus has been experimentally induced, or from culture media in which the tetanus bacillus has been artificially grown; nor indeed whether any other tissues of the tetanus subject, as, for instance, the spinal cord, contain, in greater amount than the blood and spleen, those metabolic products of this bacterium upon which the disease tetanus would

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seem to depend. The result of Dr. Martin's further research in these directions, will form the subject of an additional report.

The albumoses obtained by Dr. Martin from the blood and spleen of tetanus when intravenously injected into rabbits, cause only rise of temperature; in none of the animals experimented with, was there any suggestion of tonic or clonic muscular spasm. He regards these tetanus albumoses, therefore, as in no way concerned in the causation of the symptoms which are characteristic of the tetanus seizure. But it is otherwise with certain non-proteid substances (the acid organic bodies already referred to), also obtained by him from the blood and spleen of his tetanus cases. These, as separated out in an ether extract of the above tissues, produce in rabbits and in mice, and indifferently by intravenous and by subcutaneous injection, definite and recurring spasms of the voluntary muscles closely corresponding to the seizures which characterise tetanus in the human subject. What is the precise nature chemically of the acid organic body, or bodies, contained in the ether extract from the blood and spleen of tetanus, is a question that is now occupying Dr. Martin's attention.

Bacteriology of Common Catarrh.

Dr. Cautley has, as directed, commenced investigation (Appendix B., No. 6) of the relations, pathological and bacteriological, between the comparatively insignificant feverish catarrh which obtains the name of "influenza cold" and the more serious malady known as epidemic influenza. He has so far minutely studied 10 cases of "cold" of the above description, occurring at a season when influenza was not prevalent, but has not discovered any ground for regarding febrile nasal and naso-pharyngeal catarrh as having kinship with influenza properly so-called. Bacteriologically, indeed, he has not found the bacillus of influenza present in the nasal secretion of a single one of the cases of catarrh studied by him; and, further, these cases, while all of them affording many and various microbes, differed widely *inter se* as regards the organism, or organisms, most abundant in their secretions.

For the rest, Dr. Cautley has sought to ascertain (Appendix B., No. 7) which among the microbes that, like those now in question, get entrance to the human body presumably by way of the respiratory tract, are able to find lodgment in the thoracic glands; and similarly (Appendix B., No. 8) what are the microbes that entering the body by way of the alimentary tract may be detected in the glands of the mesentery. To this end he has examined, as cover-glass specimens and by culture, samples of the bronchial and mesenteric glands from the bodies of 30 persons whose death had resulted from accident, from acute disease, or from chronic malady.

In the Bronchial Glands.

With reference to the *bronchial glands*, Dr Cautley found, in 60 per cent. of his cases, that no organisms were present, or at least none that would grow on the culture media (gelatine and agar) employed by him; and as regards the other 40 per cent.,

such microbes as were found by him were in no single instance abundantly present, and few of them were bacteria of recognised pathogenicity. Tubercle bacilli were detected in only two instances, but bacillus coli was present in one half of the cases in which culture of the bronchial glands yielded living bacteria. As regards the *mesenteric glands*, the facts observed by him were similar. Only exceptionally did these glands contain living organisms, and rarely was any one species abundantly present. The microbes identified were among those normally inhabiting the alimentary canal; the tubercle bacillus was in no instance found, and bacillus coli less often than had been the case with the bronchial glands.

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AND OF THE MESENTERIC GLANDS.

I have the honour to be,

Sir,

Your obedient Servant,

R. THORNE THORNE.

June 1895.

APPENDICES.

APPENDIX A.

No. 1.

DIGEST of the VACCINATION OFFICERS' RETURNS (made up to the 31st January 1893), with regard to CHILDREN whose BIRTHS were registered in the Year 1891.

THE following is the twentieth annual return under the Vaccination Act, 1871. Of 914,079 births returned to the Board by the several Vaccination Officers in England and Wales, as registered during the year 1891, the number which by the 31st January 1893 had been registered as successfully vaccinated was 693,117. This number is 75·8 per cent. of the whole. The children whose births were registered during the year, and who were not recorded as successfully vaccinated, numbered 220,962. Of this number, 96,351 were registered as having died unvaccinated. Out of the same number, 1,806 had been registered as insusceptible of vaccination; 9 as having contracted small-pox and, therefore, not needing to be vaccinated; 13,823 as having their vaccination postponed by medical certificate; and there remained on the Vaccination Officers' registers 108,973 children born in 1891, who had "removed," were "not to be traced," or were otherwise unaccounted for. If from the 914,079 births returned by these officers deduction of the deaths without vaccination be first made, it appears that of the remaining 817,728 children, there were registered at the time of the return 84·8 per cent. as successfully vaccinated; 0·2 per cent. as either insusceptible of vaccination, or as having had small-pox; and 1·7 per cent. as under medical certificate of postponement; leaving 13·3 per cent. as at that time still unaccounted for as regards vaccination.

The per-centage of children not finally accounted for as regards vaccination (*i.e.*, including cases postponed) was 13·4 of the total births (914,079); and this figure is given in the Summary of Returns, in sequence to the records of former years.

By the latter method of computation, it appears that the proportion of cases not finally accounted for in the metropolitan returns for 1891 was 16·4 per cent.; in the provincial returns, 12·9. Of the registered

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births of the twenty years 1872–91, the corresponding proportion not finally accounted for in regard to vaccination in each year respectively has been as follows:—

—	Metropolis.	Rest of England.	—	Metropolis.	Rest of England.
1872	8·8	4·5	1882	6·6	4·3
1873	8·7	4·2	1883	6·8	4·5
1874	8·5	4·1	1884	6·8	5·8
1875	9·3	3·8	1885	7·0	5·5
1876	6·5	4·0	1886	7·8	6·1
1877	7·1	4·1	1887	9·0	6·7
1878	7·1	4·3	1888	10·3	8·2
1879	7·8	4·5	1889	11·6	9·6
1880	7·0	4·5	1890	13·9	10·9
1881	5·7	4·8	1891	16·4	12·9

In 1891 the proportion of cases unaccounted for, after deduction of the postponed cases, in the metropolis and in the rest of England, was 14·7 and 11·4 per cent. respectively.

	Returns, 1891.							
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.
ENGLAND & WALES -	914,079	693,117	1,806	9	96,351	13,823	108,973	13·4
Ditto (excluding Metropolitan Unions).	779,558	594,678	1,374	8	82,800	11,531	89,167	12·9
Metropolitan Unions -	134,521	98,439	432	1	13,551	2,292	19,806	16·4
COUNTIES.								
England:								
Bedford - - -	4,700	2,447	10	—	480	89	1,674	37·5
Berks - - -	7,497	6,249	11	—	649	110	478	7·8
Bucks - - -	4,904	4,220	11	—	427	59	187	5·0
Cambridge - -	5,483	4,762	3	—	497	82	139	4·0
Chester - - -	21,413	18,065	36	—	2,219	292	801	5·1
Cornwall - - -	8,922	6,610	6	1	953	170	1,182	15·2
Cumberland - -	8,406	6,784	8	—	321	211	582	9·4
Derby - - -	14,312	10,597	22	—	1,513	151	2,029	15·2
Devon - - -	17,396	14,528	17	1	1,542	300	1,008	7·5
Dorset - - -	5,140	4,146	3	—	363	58	570	12·2
Durham - - -	39,244	30,515	59	—	4,735	681	3,254	10·0
Essex - - -	25,020	19,892	63	—	2,155	548	2,362	11·6
Gloucester - -	15,858	10,959	32	—	1,606	372	2,889	20·6
Hereford - - -	3,015	2,516	2	—	293	56	148	6·8
Herts - - -	7,121	5,669	11	—	562	80	799	12·3
Huntingdon - -	1,367	1,212	1	—	109	14	31	3·3
Kent (extra-metrop.) -	22,896	18,791	56	—	2,076	355	1,618	8·6
Lancaster - -	132,954	99,057	259	—	15,942	1,988	15,708	13·3
Leicester - - -	12,454	2,769	5	—	1,851	55	7,774	62·9
Lincoln - - -	13,125	10,639	16	—	1,334	346	790	8·7
Middlesex (ex.-metro.)	16,458	13,038	55	—	1,322	142	1,901	12·4
Monmouth - -	10,035	8,148	16	—	1,084	206	581	7·8
Norfolk - - -	13,533	9,533	18	—	1,498	146	2,338	18·4
Northampton - -	9,644	3,458	5	—	1,064	86	5,031	53·1
Northumberland -	17,302	13,565	18	—	2,050	527	1,142	9·6
Nottingham - -	16,682	12,722	26	—	1,912	276	1,746	12·1
Oxford - - -	5,303	4,130	7	—	501	77	588	12·5

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Digest of Vaccination Officers Returns, 1891.

—	Returns, 1891.							
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.
COUNTIES—*cont.*								
ENGLAND—*cont.*								
Rutland	544	463	1	—	64	2	14	2·9
Salop	6,243	5,395	7	—	591	86	264	5·0
Somerset	14,677	11,984	23	—	1,323	199	2,048	15·3
Southampton	18,501	15,741	28	—	1,470	266	1,066	6·8
Stafford	34,407	26,861	55	1	4,126	415	2,949	9·8
Suffolk	10,487	8,509	11	—	992	107	967	10·2
Surrey (extra-metro.)	15,245	12,913	21	—	1,226	338	1,672	13·0
Sussex	14,173	10,913	18	—	1,176	256	1,810	14·6
Warwick	25,699	19,195	61	—	2,814	206	3,963	16·1
Westmorland	1,824	1,618	3	—	150	16	37	2·9
Wilts	7,395	5,832	2	—	571	149	561	9·9
Worcester	19,016	15,875	43	1	1,862	234	1,001	6·2
York, East Riding	12,647	10,331	73	—	1,358	128	757	7·0
York, North Riding	11,166	9,052	16	—	1,173	178	747	8·3
York, West Riding	77,216	54,307	187	4	9,205	636	12,887	17·5
WALES.								
Anglesey	892	779	—	—	71	16	26	4·7
Brecknock	1,594	1,325	1	—	165	20	73	6·5
Cardigan	1,594	1,356	—	—	169	24	75	6·2
Carmarthen	4,208	3,676	1	—	402	73	56	3·1
Carnarvon	3,184	2,642	3	—	291	35	213	7·8
Denbigh	2,903	2,399	2	—	284	39	59	4·2
Flint	2,411	1,997	3	—	220	36	103	5·3
Glamorgan	26,810	23,483	58	—	2,014	336	913	4·7
Merioneth	1,623	1,375	—	—	194	23	21	3·3
Montgomery	1,774	1,481	—	—	164	29	60	5·0
Pembroke	2,347	1,984	1	—	239	54	69	5·2
Radnor	494	346	—	—	43	14	77	18·8

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Digest of Vaccination Officers' Returns, 1891.

METROPOLITAN UNIONS.	Returns, 1891.							
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.
Bethnal Green	5,001	2,457	6	—	629	43	1,866	38.2
Camberwell	7,360	5,408	24	—	650	246	1,032	17·4
Chelsea	2,829	2,069	2	—	285	24	449	16·7
Fulham	6,430	5,337	36	—	684	61	312	5·8
George, St., Hanover Sq.	3,101	2,700	16	—	271	19	95	3·7
George, St., in the East	1,962	1,599	4	—	191	12	156	8·6
Giles, St., and St. George	1,163	842	2	—	161	3	155	13·6
Greenwich	5,415	3,839	22	—	501	193	860	19·4
Hackney	7,001	3,474	19	—	665	46	2,797	40·6
Hampstead	1,521	1,294	11	—	108	13	95	7·1
Holborn	5,090	3,868	7	1	569	45	600	12·7
Islington	9,823	7,584	33	—	1,145	131	930	10·8
Kensington	3,823	3,104	9	—	344	48	318	9·6
Lambeth	9,117	6,621	38	—	998	127	1,333	16·0
Lewisham	2,481	2,121	8	—	199	14	139	6·2
London, City of	674	541	7	—	67	5	54	8·8
Marylebone	4,519	3,446	4	—	464	161	444	13·4
Mile End Old Town	4,131	1,760	9	—	300	159	1,903	49·9
Olave, St.	5,094	3,732	14	—	567	157	624	15·3
Paddington	2,968	2,172	16	—	254	32	494	17·7
Pancras, St.	7,210	5,363	39	—	681	221	906	15·6
Poplar	6,126	4,273	29	—	624	15	1,185	19·6
Saviour, St.	7,243	5,488	12	—	848	84	811	12·4
Shoreditch	4,615	3,633	10	—	567	50	355	8·8
Stepney	1,998	1,406	8	—	204	—	380	19·0
Strand	559	398	—	—	93	13	55	12·2
Wandsworth and Clapham	9,749	7,469	36	—	815	293	1,136	14·7
Westminster	852	623	2	—	82	44	101	17·0
Whitechapel	3,069	2,690	4	—	250	9	116	4·1
Woolwich	3,597	3,128	5	—	335	24	105	3·6
	134,521	8,439	432	1	18,551	2,292	19,806	16·4

APP. A. No. 1

Duties of Vaccination Officers Returns 1891.

	Returns, 1891.							
	Births.	Successful Vaccinations.	Unsuccessful Vaccinations.	Died Small-pox.	Died unvaccinated.	Vaccinations postponed.	Remaining.	Children, not Insusceptible, who have attained the age of 14 years during the year and who have not been Vaccinated.
BEDFORD.								
Ampthill - -	413	331	1	—	33	15	37	4
Biggleswade - -	1,066	766	1	—	15	12	40	4
Leighton Buzzard -	1,305	1,135	—	—	28	3	139	11
Luton - -	1,846	1,567	1	—	28	3	1,000	11
Woburn - -	170	174	—	—	14	1	46	2
BERKS.								
Abingdon - -	502	354	—	—	—	—	11	—
Bradfield - -	168	115	1	—	—	—	—	—
Eastbury - -	301	208	—	—	—	—	3	—
Hungerford - -	487	311	—	—	—	—	—	—
Newbury - -	1,000	1,000	1	—	26	2	14	1
Wantage - -	1,000	1,000	1	—	26	2	14	1
Windsor - -	1,000	1,000	1	—	26	2	14	1
Wokingham - -	491	365	3	—	5	4	57	11
BUCKS.								
Amersham - -	632	349	1	—	—	9	10	44
Aylesbury - -	1,000	1,000	2	—	18	18	44	11
Eton - -	1,000	1,000	2	—	18	18	44	11
Newport Pagnell -	1,000	1,000	2	—	18	18	44	11
Winslow - -	1,000	1,000	2	—	18	18	44	11
Wycombe - -	1,000	1,000	2	—	18	18	44	11
CAMBRIDGE.								
Cambridge - -	906	582	1	—	—	2	8	—
Caxton and Arrington	1,000	1,000	1	—	—	2	8	—
Chesterton - -	1,000	1,000	1	—	—	2	8	—
Ely - -	1,000	1,000	1	—	—	2	8	—
Linton - -	1,000	1,000	1	—	—	2	8	—
Newmarket - -	1,000	1,000	1	—	—	2	8	—
North Witchford -	1,000	1,000	1	—	—	2	8	—
Wisbech - -	1,000	1,000	1	—	—	2	8	—
Wisbech - -	1,000	1,000	1	—	—	2	8	—
CHESTER.								
Altrincham - -	1,000	1,000	—	—	—	—	—	—
Birkenhead - -	1,000	1,000	—	—	—	—	—	—
Chester - -	1,000	1,000	—	—	—	—	—	—
Congleton - -	1,000	1,000	—	—	—	—	—	—
Macclesfield - -	1,000	1,000	—	—	—	—	—	—
Nantwich - -	1,000	1,000	—	—	—	—	—	—
Northwich - -	1,000	1,000	—	—	—	—	—	—
Runcorn - -	1,000	1,000	—	—	—	—	—	—
Stockport - -	1,000	1,000	—	—	—	—	—	—
Tarporley - -	1,000	1,000	—	—	—	—	—	—
Wirral - -	1,000	1,000	—	—	—	—	—	—

—	Returns, 1891.							
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent of births.
CORNWALL.								
Austell, St.	956	815	1	—	94	26	20	4·8
Bodmin	480	401	—	—	42	7	30	7·7
Camelford	204	174	—	—	22	6	2	3·9
Columb, St., Major	373	337	—	—	22	6	8	3·8
Falmouth	609	147	2	—	70	3	387	64·0
Germans, St.	489	434	—	—	35	11	9	4·1
Helston	680	544	—	—	75	27	34	9·0
Launceston	448	405	—	—	30	4	9	2·9
Liskeard	739	612	1	—	59	11	56	9·1
Penzance	1,368	1,039	—	—	161	17	151	12·3
Redruth	1,525	975	—	—	228	31	291	21·1
Stratton	187	155	—	—	20	5	7	6·4
Truro	864	572	2	1	95	16	178	22·5
CUMBERLAND.								
Alston-with-Garrigill	81	72	—	—	5	—	4	4·9
Bootle	450	330	—	—	45	18	57	16·7
Brampton	233	196	—	—	12	18	7	10·7
Carlisle	1,596	1,366	3	—	149	59	19	4·9
Cockermouth	2,611	1,887	1	—	288	74	361	16·7
Longtown	177	150	1	—	11	3	12	8·5
Penrith	626	553	1	—	62	3	7	1·6
Whitehaven	1,954	1,665	2	—	175	17	95	5·7
Wigton	678	565	—	—	74	19	20	5·8
DERBY.								
Ashbourne	576	500	—	—	52	2	22	4·2
Bakewell	852	728	2	—	61	24	37	7·2
Belper	2,161	1,916	1	—	195	12	37	2·3
Chapel-en-le-Frith	681	542	2	—	74	18	45	9·3
Chesterfield	4,283	2,863	6	—	496	64	854	21·4
Derby	2,914	1,681	5	—	368	3	857	29·5
Glossop	747	581	2	—	99	4	61	8·7
Hayfield	349	308	—	—	31	1	9	2·9
Shardlow	1,749	1,478	4	—	137	23	107	7·4
DEVON.								
Axminster	423	385	—	—	26	6	6	2·8
Barnstaple	1,195	1,027	—	—	101	36	31	5·6
Bideford	609	537	—	—	47	19	6	4·1
Crediton	472	411	—	—	31	—	30	6·4
East Stonehouse	531	373	—	—	67	9	82	17·1
Exeter	1,077	839	—	—	115	46	77	11·4
Holsworthy	255	231	—	—	16	3	5	3·1
Honiton	548	479	1	—	42	8	18	4·7
Kingsbridge	442	406	—	—	28	—	8	1·8
Newton Abbot	1,873	1,700	5	—	121	10	37	2·5
Okehampton	437	387	—	—	35	3	12	3·4
Plymouth	2,535	1,931	4	—	312	27	261	11·4
Plympton St. Mary	695	558	—	—	56	4	77	11·7
Southmolton	418	374	—	—	37	6	1	1·7
Stoke Damerel	1,556	1,149	1	1	161	49	195	15·7
Tavistock	707	623	—	—	58	5	21	3·7
Thomas, St.	1,377	1,155	1	—	119	40	62	7·4
Tiverton	770	662	2	—	61	16	29	5·8
Torrington	350	311	—	—	22	5	12	4·9
Totnes	1,126	990	3	—	87	8	38	4·1

ART. 4, No. 1.

Report of Vaccination Officers Returns, 1891.

	Returns, 1891.							
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated	Vaccination postponed.	Remaining	Children not Primarily Vaccinated but Successfully Vaccinated within the year of birth. Cases postponed per cent. of births.
DORSET								
[illegible]	301	295	1		24	3	11	4
[illegible]	339	291	1		19	1	21	4
[illegible]	343	277			25	3	3	3
[illegible]	183	166			16	3	4	3
[illegible]	471	423			27	6	16	4
[illegible]	825	714	2		61	13	36	4
[illegible]	280	248			16	4	17	3
[illegible]	377	325			18	4	21	3
[illegible]	297	239			20	1	17	3
Wimborne and Purbeck	402	407			34	4	1	3
[illegible]	391	379			62	1	383	45
Weymouth and Cranborne	368	414			41	13	46	10
DURHAM.								
[illegible]	5,039	3,785	7		435	91	308	11
[illegible] Street	2,037	1,691	3		203	14	66	4
[illegible]	439	363	1		18	9	378	25
[illegible]	1,865	1,496	1		347	25	87	4
[illegible]	1,868	1,811	3		219	29	39	2
[illegible]	1,998	1,443	10		160	100	585	10
[illegible]	2,000	2,145	6		200	31	44	2
[illegible]-le-Spring	1,000	1,758	9		188	24	87	4
[illegible]	1,331	1,303	2		232	32	132	4
[illegible]	1,111	1,000			83	13	93	4
[illegible]	2,401	2,000	6		672	100	611	14
[illegible]	2,100	2,000	1		318	58	242	14
[illegible]	1,175	1,000	11		201	81	366	4
[illegible]	623	488			31	7	98	10
Weardale	490	465	1		43	4	8	2
ESSEX.								
[illegible]	515	495	5		35	25	37	
[illegible]	699	694	2		42	16	13	3
[illegible]	923	748			73	23	42	3
[illegible]	846	750	7		76	6	87	11
[illegible]	440	446	1		34	3	8	
[illegible]	870	822	2		58	6	35	
[illegible]	152	135			36	6	8	
[illegible] Winstree	730	682			42	6	48	
[illegible]	760	760			53			
[illegible]	373	295			28	14		
[illegible]	288	277	7		24	2	13	3
[illegible]	800	780	1		74	11	13	
[illegible]	1,715	1,603			135	28	85	4
[illegible] Walden	460	414			73	1	20	
[illegible]	1,450	1,405	1		73	11	60	
West Ham.	5,597	14,849	37		1,220	502	1,515	5
GLOUCESTER.								
[illegible] Regis	1,000	1,000	23		105	126	204	
[illegible]	1,000	1,000	4		236	18	113	
[illegible]	1,700	1,700	2		144	9	73	
[illegible] Sudbury	300	351			62	6	2	
[illegible]	340	300			40	6	16	
[illegible]	311	300			32	6	2	
[illegible]	1,600	1,500			120	1	1,53	
[illegible]	1,000	1,000			80	6	20	
[illegible]	300	250			30	6	20	
[illegible]	206	201			30	3	13	

	Returns, 1891.							
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.
GLOUCESTER—*cont.*								
Stow-on-the-Wold	235	200	—	—	16	9	10	8·1
Stroud	1,084	877	2	—	98	24	83	9·9
Tetbury	150	81	—	—	18	—	51	34·0
Tewkesbury	400	201	—	—	45	3	151	38·5
Thornbury	458	406	—	—	32	7	13	4·4
Westbury-on-Severn	812	418	1	—	105	27	261	35·5
Wheatenhurst	170	62	—	—	14	13	81	55·3
Winchcomb	242	210	—	—	17	5	10	6·2
HEREFORD.								
Bromyard	281	217	1	—	25	7	31	13·5
Dore	224	180	—	—	31	3	10	5·8
Hereford	872	735	—	—	68	29	40	7·9
Kington	293	251	—	—	35	1	6	2·4
Ledbury	362	308	1	—	33	—	20	5·5
Leominster	340	287	—	—	33	10	10	5·9
Ross	459	377	—	—	54	4	24	6·1
Weobley	184	161	—	—	14	2	7	4·9
HERTS.								
Albans, St.	774	331	—	—	93	10	340	45·2
Barnet	1,234	1,006	3	—	92	33	100	10·8
Berkhampstead	440	378	—	—	44	2	16	4·1
Bishop's Stortford	561	504	—	—	36	2	19	3·7
Buntingford	158	137	—	—	6	1	14	9·4
Hatfield	190	168	—	—	11	—	11	5·8
Hemel Hempstead	424	327	—	—	28	6	63	16·3
Hertford	478	417	—	—	26	6	29	7·3
Hitchin	773	676	1	—	71	1	24	3·2
Royston	468	431	1	—	25	—	11	2·4
Ware	492	430	1	—	38	4	19	4·7
Watford	1,069	809	5	—	88	15	152	15·6
Welwyn	60	55	—	—	4	—	1	1·7
HUNTINGDON.								
Huntingdon	530	476	—	—	40	2	12	2·6
Ives, St.	425	378	1	—	33	5	8	3·1
Neots, St.	412	358	—	—	36	7	11	4·4
KENT (Extra-Metropolitan).								
Ashford, East	395	337	2	—	39	—	17	4·3
Ashford, West	538	432	1	—	54	14	37	9·5
Blean	564	486	1	—	39	11	27	6·7
Bridge	324	268	—	—	27	10	19	9·0
Bromley	1,890	1,511	3	—	263	51	62	6·0
Canterbury	474	412	1	—	37	2	22	5·1
Cranbrook	335	299	—	—	20	4	12	4·8
Dartford	2,276	1,825	6	—	201	37	207	10·7
Dover	1,130	867	2	—	105	30	136	14·7
Eastry	764	698	—	—	56	3	7	1·3
Elham	1,091	895	5	—	109	9	73	7·5
Faversham	781	702	10	—	58	3	8	1·4
Gravesend and Milton	651	455	6	—	64	—	126	19·3
Hollingbourn	329	283	—	—	29	2	15	5·2
Hoo	149	132	—	—	17	—	—	0·0
Maidstone	1,299	990	2	—	133	15	159	13·2

App. A. No. 1.

Digest of Vaccination Officers' Returns, 1891.

	Returns, 1891.							
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.
KENT (Extra-Metropolitan)—*cont.*								
Malling	881	769	2	—	68	8	43	5·4
Medway	2,269	1,943	3	—	198	27	99	5·8
Milton	809	677	—	—	68	40	24	7·9
Romney Marsh	217	196	—	—	15	1	5	9·6
Sevenoaks	842	724	2	—	57	19	40	7·6
Sheppey	523	475	1	—	35	6	6	2·4
Strood	1,283	1,096	4	—	115	11	57	5·3
Tenterden	288	240	—	—	26	5	8	4·5
Thanet, Isle of	1,391	1,236	—	—	101	9	45	3·9
Tonbridge	1,412	983	5	—	142	38	364	28·3
LANCASTER.								
Ashton-under-Lyne	5,077	2,975	10	—	650	72	1,370	28·4
Barrow-in-Furness	1,932	1,681	—	—	179	5	67	3·7
Barton-upon-Irwell	2,830	2,342	5	—	321	75	87	5·7
Blackburn	6,864	5,349	13	—	821	94	587	9·9
Bolton	7,838	6,957	16	—	636	11	178	2·4
Burnley	5,728	3,278	20	—	789	143	1,498	28·3
Bury	4,137	2,549	6	—	530	7	1,046	25·5
Chorley	1,798	1,468	2	—	189	22	117	7·7
Clayton	9,446	7,298	12	—	1,205	221	711	9·9
Clitheroe	627	507	—	—	66	26	38	10·2
Fylde, The	1,478	1,180	4	—	192	38	64	6·9
Garstang	335	295	—	—	23	1	16	5·1
Haslingden	3,013	2,374	2	—	308	38	291	19·9
Lancaster	1,556	1,311	7	—	166	19	53	4·6
Leigh	2,815	2,348	3	—	290	—	174	6·2
Liverpool	5,002	4,153	10	—	634	8	197	4·1
Lunesdale	190	167	—	—	15	3	5	4·2
Manchester	5,076	4,080	3	—	715	37	141	3·1
Oldham	6,319	303	4	—	1,642	6	4,364	78·1
Ormskirk	2,730	2,341	11	—	270	30	138	6·0
Prescot	5,380	4,295	20	—	686	105	276	7·1
Preston	4,872	3,540	8	—	782	47	495	11·1
Prestwich	4,984	3,937	3	—	485	196	353	11·2
Rochdale	3,174	2,566	10	—	344	48	206	8·4
Salford	7,407	5,477	10	—	1,020	180	770	12·9
Todmorden	930	625	—	—	105	—	199	21·4
Toxteth Park	4,278	3,095	15	—	502	150	516	12·6
Ulverston	1,310	1,124	6	—	111	—	70	5·4
Warrington	3,354	2,835	13	—	354	20	132	4·0
West Derby	15,321	12,834	27	—	1,626	152	682	5·1
Wigan	7,053	5,716	19	—	806	224	294	7·3
LEICESTER.								
Ashby-de-la-Zouch	1,282	817	—	—	150	17	308	25·3
Barrow-on-Soar	1,146	97	1	—	152	1	895	78·1
Billesdon	406	124	1	—	44	4	231	58·2
Blaby	1,260	120	1	—	173	3	963	76·7
Hinckley	763	199	—	—	94	3	471	62·1
Leicester	4,785	74	1	—	885	—	3,825	79·9
Loughborough	955	166	—	—	147	3	640	67·1
Lutterworth	273	248	—	—	28	6	21	9·2
Market Bosworth	518	390	1	—	71	5	51	9·7
Market Harborough	459	228	—	—	44	13	175	39·5
Melton Mowbray	639	264	—	—	74	—	293	46·5

	Returns, 1891.							
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.
LINCOLN.								
Boston	1,012	842	1	—	91	47	31	7·7
Bourn	503	395	—	—	57	29	22	10·1
Caistor	432	369	1	—	38	8	16	5·6
Gainsborough	1,043	838	—	—	110	13	82	9·1
Glanford Brigg	1,208	1,041	2	—	117	13	35	4·0
Grantham	948	815	2	—	82	10	39	5·2
Grimsby	2,051	1,580	3	—	245	76	147	10·9
Holbeach	505	370	—	—	55	7	73	15·8
Horncastle	500	422	—	—	45	8	25	6·6
Lincoln	1,898	1,463	5	—	245	82	103	9·7
Louth	758	631	1	—	75	19	32	6·7
Sleaford	667	535	1	—	48	6	77	12·4
Spalding	561	448	—	—	47	8	58	11·8
Spilsby	624	541	—	—	43	16	24	6·4
Stamford	415	349	—	—	36	4	26	7·2
MIDDLESEX (Extra-Metropolitan).								
Brentford	3,901	3,187	21	—	348	71	334	8·8
Edmonton	7,844	6,174	16	—	596	73	985	13·5
Hendon	3,088	2,397	13	—	242	22	414	14·1
Staines	737	517	4	—	65	23	128	20·5
Uxbridge	888	763	1	—	71	13	40	6·0
MONMOUTH.								
Abergavenny	785	673	6	—	79	7	20	3·4
Bedwellty	2,654	2,089	—	—	313	82	170	9·5
Chepstow	608	498	—	—	60	5	45	8·2
Monmouth	838	666	—	—	74	26	72	11·7
Newport	3,650	3,055	9	—	394	44	148	5·3
Pontypool	1,500	1,167	1	—	164	42	126	11·2
NORFOLK.								
Aylsham	521	446	—	—	58	7	10	3·3
Blofield	344	286	—	—	39	9	10	5·5
Depwade	673	554	1	—	70	15	33	7·1
Docking	425	372	—	—	38	4	11	3·5
Downham	511	434	—	—	59	2	16	3·5
Erpingham	556	476	1	—	47	11	21	5·8
Faith, St.	356	253	—	—	38	4	61	18·3
Fleggs, East and West	323	277	—	—	33	3	10	4·0
Forehoe	358	293	—	—	29	5	31	10·1
Freebridge Lynn	343	279	1	—	30	6	27	9·6
Guiltcross	271	232	—	—	25	—	14	5·2
Henstead	296	231	1	—	32	—	32	10·8
King's Lynn	586	81	—	—	88	—	417	71·2
Loddon and Clavering	357	316	—	—	26	—	15	4·2
Mitford and Launditch	722	613	—	—	81	8	20	3·9
Norwich	3,217	1,458	4	—	432	7	1,316	41·1
Smallburgh	494	398	1	—	50	5	40	9·1
Swaffham	333	239	—	—	25	5	64	20·7
Thetford	492	425	—	—	42	4	21	5·1
Walsingham	551	459	2	—	55	12	23	6·4
Wayland	276	220	2	—	35	7	12	6·9
Yarmouth, Great	1,528	1,191	5	—	166	32	134	10·9

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Digest of Vaccination Returns, &c.

	Returns, 1891.							
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not [illegible] per cent. of births.
NORTHAMPTON.								
Brackley	296	176	—	—	24	16	80	34·1
Brixworth	318	222	—	—	40	4	48	17·6
Daventry	448	372	1	—	40	13	22	7·6
Hackleton	309	214	—	—	19	6	65	23·1
Kettering	1,274	163	3	—	145	2	960	75·3
Northampton	2,700	166	—	—	369	23	2,143	80·6
Oundle	308	209	—	—	20	5	13	6·3
Peterborough	1,345	1,188	—	—	97	2	58	4·5
Potterspury	350	271	1	—	43	13	32	17·5
Towcester	300	83	—	—	39	—	228	67·9
Towcester	317	248	—	—	30	4	35	12·3
Wellingborough	1,350	61	—	—	190	—	1,260	85·2
NORTHUMBERLAND.								
Alnwick	633	531	1	—	59	13	29	6·6
Belford	140	121	—	—	7	—	1	0·8
Berwick	180	124	—	—	4	—	3	2·3
Berwick-upon-Tweed	497	455	1	—	34	4	3	1·4
Castle Ward	770	690	1	—	91	5	58	7·5
Glendale	203	193	—	—	14	—	6	2·8
Hexham	193	132	2	—	18	7	54	21·2
Hexham	887	705	—	—	86	9	87	10·8
Morpeth	1,342	1,069	2	—	327	22	132	9·9
Newcastle-on-Tyne	7,178	5,756	7	—	810	194	434	8·7
Rothbury	139	120	—	—	16	2	1	2·2
Tynemouth	4,390	3,760	4	—	584	271	362	13·7
NOTTINGHAM.								
Basford	5,976	4,801	14	—	724	130	497	10·5
Bingham	350	264	—	—	29	—	57	16·3
East Retford	697	572	2	—	63	5	15	3·0
Mansfield	2,295	1,642	1	—	238	25	388	14·6
Newark	824	727	—	—	66	6	25	3·8
Nottingham	5,078	3,483	3	—	634	96	813	18·0
Southwell	493	411	—	—	51	9	22	6·3
Worksop	1,134	1,022	1	—	87	6	18	2·1
OXFORD.								
Banbury	785	293	1	—	99	23	369	51·1
Bicester	581	328	—	—	58	6	31	6·6
Chipping Norton	522	418	—	—	45	5	54	21·8
Headington	965	868	1	—	78	4	14	1·9
Henley	648	537	—	—	66	10	35	6·8
Oxford	617	509	4	—	60	13	29	7·1
Thame	365	314	—	—	36	7	14	7·1
Witney	629	545	1	—	65	6	12	2·9
Woodstock	391	318	—	—	44	4	25	7·4
RUTLAND.								
Oakham	275	228	—	—	34	1	2	1·1
Uppingham	269	225	1	—	30	1	12	4·8

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Digest of Vaccination Officers' Returns, 1891.

	Returns, 1891.							
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.
SALOP.								
Atcham	1,225	1,017	2	—	114	25	67	7·5
Bridgnorth	379	306	—	—	29	5	39	11·6
Church Stretton	133	108	—	—	19	2	4	4·5
Cleobury Mortimer	236	210	—	—	15	4	7	4·7
Clun	243	192	—	—	30	3	18	8·6
Drayton	373	334	—	—	32	3	4	1·9
Ellesmere	354	310	—	—	40	3	1	1·1
Ludlow	483	398	—	—	43	11	31	8·7
Madeley	679	621	1	—	44	1	12	1·9
Newport	407	358	—	—	44	—	5	1·2
Oswestry	811	725	2	—	59	8	17	3·1
Shifnal	305	247	—	—	27	11	20	10·2
Wellington	745	646	—	—	64	5	30	4·7
Wem	263	245	2	—	16	—	—	0·0
Whitchurch	307	278	—	—	15	5	9	4·6
SOMERSET.								
Axbridge	1,077	503	—	—	117	6	451	42·4
Bath	1,855	1,194	—	—	165	47	449	26·7
Bedminster	2,610	1,732	7	—	280	16	575	22·6
Bridgwater	979	757	3	—	101	22	96	12·1
Chard	689	588	1	—	63	14	23	5·4
Clutton	812	718	—	—	60	5	29	4·2
Dulverton	141	129	—	—	7	2	3	3·5
Frome	658	565	1	—	55	—	37	5·6
Keynsham	1,061	761	1	—	120	11	168	16·9
Langport	385	351	1	—	17	5	11	4·2
Shepton Mallet	465	403	1	—	21	4	36	8·6
Taunton	1,019	854	3	—	93	17	52	6·8
Wellington	503	445	1	—	32	6	19	5·0
Wells	711	609	1	—	62	10	29	5·5
Williton	436	391	—	—	33	7	5	2·8
Wincanton	513	452	3	—	25	3	30	6·4
Yeovil	763	632	—	—	72	24	35	7·7
SOUTHAMPTON.								
Alresford	170	158	—	—	8	2	2	2·4
Alton	382	333	—	—	29	4	16	5·2
Alverstoke	809	721	1	—	60	3	24	3·3
Andover	404	341	—	—	28	6	29	8·7
Basingstoke	551	334	—	—	45	2	170	31·2
Catherington	91	74	1	—	9	3	4	7·7
Christchurch	1,316	963	1	—	124	34	194	17·3
Droxford	306	268	2	—	23	4	9	4·2
Fareham	505	452	—	—	34	1	18	3·8
Fordingbridge	182	157	1	—	14	—	10	5·5
Hartley Wintney	613	494	2	—	66	10	41	8·3
Havant	287	263	—	—	16	2	6	2·8
Hursley	80	71	—	—	4	1	4	6·2
Kingsclere	265	239	1	—	22	—	3	1·1
Lymington	319	260	—	—	27	3	29	10·0
New Forest	389	345	—	—	25	9	10	4·9
Petersfield	311	276	—	—	18	5	14	6·4
Portsea Island	4,826	4,315	8	—	387	20	96	2·4
Ringwood	158	146	—	—	8	—	4	2·5
Romsey	299	278	—	—	18	—	3	1·9
Southampton	1,714	1,365	4	—	157	43	145	11·0
South Stoneham	1,538	1,291	1	—	127	28	91	7·7
Stockbridge	166	139	—	—	14	3	10	7·8
Whitchurch	175	150	—	—	14	6	5	6·3
Wight, Isle of	1,843	1,608	3	—	128	51	53	5·6
Winchester, New	802	700	3	—	67	16	16	4·0

	Returns, 1891.							
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox	Died unvaccinated.	Vaccinated postponed.	Remaining	Cases not proved to have been vaccinated in cases of proved Small-pox
STAFFORD.								
Burton-upon-Trent	2,865	2,084	2	1	322	41	415	2
[illegible]	1,437	1,159	1	1	182	1	94	1
[illegible]	779	665	1	1	63	3	46	1
[illegible]	1,079	911	2	1	114	20	53	1
[illegible]	1,538	1,145	3	1	145	4	25	1
Newcastle-under-Lyme	1,387	1,060	2	1	146	5	73	1
[illegible]	476	425	1	1	27	3	19	1
[illegible]	830	695	3	1	84	11	37	1
Stoke-upon-Trent	4,807	3,604	1	1	679	51	322	3
[illegible]	980	807	1	1	92	18	61	3
[illegible]	724	585	1	1	69	10	58	1
[illegible]	461	364	1	1	39	1	55	1
[illegible]	3,841	2,868	2	1	708	42	220	2
West Bromwich	5,197	4,146	18	1	834	167	252	2
Wednesbury and Bilston	3,275	2,710	4	1	384	8	168	1
Wolverhampton	5,043	3,640	9	1	685	81	508	14
SUFFOLK.								
[illegible]	740	627	1	1	56	4	53	1
[illegible]	483	366	1	1	46	2	44	1
[illegible]	440	360	1	1	44	17	44	1
[illegible]	500	419	1	1	42	4	44	1
[illegible]	405	361	1	1	23	1	44	1
[illegible]	346	306	1	1	30	3	44	1
[illegible]	1,784	927	6	1	177	41	44	1
[illegible]	300	238	1	1	30	1	44	1
[illegible] and Lothingland	1,146	866	2	1	97	32	44	1
[illegible]	501	440	1	1	48	2	44	1
[illegible]	537	476	1	1	38	9	44	1
[illegible]	536	506	1	1	24	4	44	1
[illegible]	591	516	1	1	35	7	44	1
[illegible]	787	672	1	1	83	17	44	1
[illegible]	473	430	1	1	33	4	44	1
[illegible]	436	366	1	1	47	6	44	1
[illegible]	670	560	1	1	62	9	44	1
SURREY (Extra-Metropolitan).								
[illegible]	832	734	1	1	61	84	44	1
[illegible]	4,003	3,000	1	1	349	7	44	1
[illegible]	1,171	853	1	1	91	1	44	1
[illegible]	1,158	931	1	1	101	36	44	1
[illegible]	1,488	1,366	2	1	144	13	44	1
[illegible]	1,271	1,000	1	1	128	6	44	1
[illegible]	1,571	1,160	4	1	119	44	44	1
[illegible]	1,114	847	1	1	86	6	44	1
[illegible]	2,011	1,485	3	1	236	37	44	1
[illegible]	1,871	1,318	1	1	98	42	44	1
[illegible]	1,107	863	1	1	86	1	44	1
SUSSEX.								
[illegible]	475	387	1	1	44	17	44	1
[illegible]	2,851	2,370	7	1	265	6	44	1
[illegible]	281	195	1	1	18	3	44	1
[illegible]	377	199	1	1	38	4	44	1
[illegible]	1,053	877	1	1	98	14	44	1
[illegible]	1,667	1,331	1	1	151	6	44	1
[illegible]	599	491	1	1	62	24	44	1
[illegible]	791	657	1	1	67	15	44	1

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Digest of Vaccination Officers' Returns, 1891.

	Returns, 1891.							
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.
SUSSEX—*cont.*								
Hailsham	430	354	1	—	36	5	34	9·1
Hastings	1,446	1,032	3	—	101	36	274	21·4
Horsham	701	599	1	—	52	12	37	7·0
Lewes	274	163	1	—	18	1	91	33·6
Midhurst	353	303	—	—	40	3	7	2·8
Newhaven	296	261	—	—	24	—	11	3·7
Petworth	251	220	—	—	26	2	3	2·0
Rye	302	258	—	—	25	4	15	6·3
Steyning	1,495	1,275	2	—	108	33	77	7·4
Thakeham	223	198	—	—	19	2	4	2·7
Ticehurst	448	343	—	—	43	5	57	13·8
Uckfield	605	381	—	—	56	12	156	27·8
Westbourne	194	175	—	—	11	3	5	4·1
West Firle	56	42	—	—	3	—	11	19·6
Westhampnett	582	527	—	—	33	5	17	3·8
WARWICK.								
Alcester	575	486	—	—	51	9	29	6·6
Aston	9,035	6,794	34	—	988	146	1,073	13·5
Atherstone	593	484	—	—	56	10	43	8·9
Birmingham	8,452	6,760	23	—	971	48	650	8·3
Coventry	1,727	587	—	—	228	—	912	52·8
Foleshill	701	451	1	—	70	—	149	21·3
Meriden	255	221	—	—	19	1	14	5·9
Nuneaton	650	302	—	—	83	—	265	40·8
Rugby	745	624	—	—	71	2	48	6·7
Solihull	835	683	3	—	74	20	55	9·0
Southam	271	230	—	—	22	3	16	7·0
Stratford-on-Avon	584	507	—	—	44	4	29	5·7
Warwick	1,276	1,036	—	—	137	23	80	8·1
WESTMORLAND.								
East Ward	366	312	—	—	45	1	8	2·5
Kendal	1,271	1,140	2	—	92	13	24	2·9
West Ward	187	166	1	—	13	2	5	3·7
WILTS.								
Alderbury	718	621	—	—	59	14	24	5·3
Amesbury	184	167	—	—	12	1	4	2·7
Bradford	287	242	—	—	36	—	9	3·1
Calne	202	167	—	—	15	8	12	9·9
Chippenham	582	500	—	—	47	25	10	6·0
Cricklade and Wootton Bassett.	333	299	—	—	24	5	10	4·4
Devizes	508	440	—	—	17	12	39	10·0
Highworth and Swindon	1,641	1,135	1	—	160	44	301	21·0
Malmesbury	319	232	—	—	24	11	52	19·7
Marlborough	224	199	—	—	18	1	6	3·1
Melksham	461	400	1	—	44	5	11	3·5
Mere	176	161	—	—	10	—	5	2·8
Pewsey	339	302	—	—	29	2	6	2·4
Tisbury	227	200	—	—	12	9	6	6·6
Warminster	318	246	—	—	26	5	41	14·5
Westbury and Whorwellsdown.	289	263	—	—	21	2	3	1·7
Wilton	292	258	—	—	17	5	12	5·8

APP. A. No. 1.

Digest of Vaccination Officers' returns, 1891.

	Returns, 1891.							
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated.	Vaccinations postponed.	Remaining.	Certificates not received, Cases postponed, and Deaths of Infants.
WORCESTER								
Bromsgrove - - -	1,691	893	2	1	82	23	49	6·9
Dodderhill - - -	551	447	—	—	21	21	12	4·5
Droitwich - - -	5,736	4,993	14	—	207	28	153	3·2
Evesham - - -	473	401	—	—	26	5	32	7·8
Kidderminster - -	1,765	1,667	1	—	4	4	7	5·0
Kidderminster Foreign -	3,119	2,661	26	—	148	37	286	11·0
Martley - - -	411	393	—	—	13	—	5	1·9
Pershore - - -	540	503	—	—	24	3	12	4·4
Stourbridge-Stourbridge -	426	383	—	—	30	7	13	4·8
Stourbridge - - -	3,137	2,747	4	—	304	21	44	2·1
Tenbury - - -	188	165	1	—	12	3	4	3·7
Upton-on-Severn - -	547	482	—	—	30	3	25	5·1
Worcester - - -	1,312	895	6	—	176	51	234	23·2
YORK, East Riding.								
Beverley - - -	780	673	—	—	61	16	40	7·7
Bridlington - - -	196	171	1	—	16	1	8	7·9
Driffield - - -	552	504	1	—	18	3	16	3·3
Howden - - -	303	269	—	—	22	—	11	3·0
Kingston-upon-Hull -	2,471	1,999	11	—	288	22	207	8·9
Patrington - - -	206	174	—	—	12	2	21	10·6
Pocklington - - -	377	330	—	—	20	4	13	4·4
Sculcoates - - -	5,744	5,010	43	—	546	28	263	6·2
Skirlaugh - - -	251	223	—	—	21	4	13	6·1
York - - -	2,847	1,877	12	—	244	48	186	7·9
YORK, North Riding.								
Aysgarth - - -	112	97	—	—	11	—	4	3·6
Easingwold - - -	211	181	—	—	13	—	4	1·4
Guisborough - - -	1,163	1,155	—	—	124	—	41	3·4
Hornby - - -	1,163	1,155	2	—	124	—	41	3·4
Kirkby Moorside - -	118	110	—	—	3	—	1	0·8
Leyburn - - -	1,163	1,155	2	—	124	—	41	3·4
Malton - - -	1,163	1,155	2	—	124	—	41	3·4
Masham - - -	1,163	1,155	2	—	124	—	41	3·4
Middlesbrough - -	4,336	3,987	2	—	311	6	30	0·7
Northallerton - -	1,163	1,155	2	—	124	—	41	3·4
Pickering - - -	1,163	1,155	2	—	124	—	41	3·4
Reeth - - -	1,163	1,155	2	—	124	—	41	3·4
Richmond - - -	1,163	1,155	2	—	124	—	41	3·4
Scarborough - - -	1,163	1,155	2	—	124	—	41	3·4
Stokesley - - -	1,163	1,155	2	—	124	—	41	3·4
Thirsk - - -	1,163	1,155	2	—	124	—	41	3·4
Whitby - - -	711	679	—	—	28	15	18	4·4
YORK, West Riding.								
Barnsley - - -	1,163	1,155	2	—	124	—	41	3·4
Barton, North - -	1,163	1,155	2	—	124	—	41	3·4
Bawtry - - -	1,163	1,155	2	—	124	—	41	3·4
Bradford - - -	2,915	2,597	1	—	211	1	105	3·6
Dewsbury - - -	1,163	1,155	2	—	124	—	41	3·4
Doncaster - - -	1,163	1,155	2	—	124	—	41	3·4
Ecclesall Bierlow -	1,163	1,155	2	—	124	—	41	3·4
Goole - - -	1,163	1,155	2	—	124	—	41	3·4
Halifax - - -	4,868	3,811	—	—	82	11	7,068	2·3

	Returns, 1891.							
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.
YORK, West Riding—*cont.*								
Hemsworth	577	485	—	—	60	6	26	5·5
Holbeck	866	722	2	—	103	11	28	4·5
Huddersfield	4,271	3,761	10	—	395	17	88	2·5
Hunslet	2,696	2,303	1	—	302	27	63	3·3
Keighley	2,036	69	—	—	276	—	1,691	83·1
Knaresborough	681	500	2	—	64	22	93	16·9
Leeds	7,396	6,158	30	—	804	43	361	5·5
Ouseburn, Great	358	307	1	—	31	6	13	5·3
Pateley Bridge	211	192	—	—	16	1	2	1·4
Penistone	571	499	1	—	49	6	16	3·9
Pontefract	2,239	1,862	2	—	291	9	75	3·8
Ripon	383	306	—	—	37	4	36	10·4
Rotherham	3,531	2,931	7	—	404	26	163	5·4
Saddleworth	609	103	—	—	86	—	420	69·0
Sedbergh	108	102	—	—	6	—	—	0·0
Selby	434	371	—	—	39	7	17	5·5
Settle	382	329	—	—	37	4	12	4·2
Sheffield	7,818	6,325	26	—	926	26	515	6·9
Skipton	1,161	709	4	—	148	33	267	25·8
Tadcaster	916	772	1	—	104	3	36	4·3
Thorne	416	329	—	—	35	13	39	12·5
Wakefield	3,245	2,679	9	—	385	23	149	5·3
Wetherby	356	282	—	—	43	4	27	8·7
Wharfedale	1,315	1,012	4	—	122	20	157	13·5
Wortley	1,549	1,296	4	—	157	12	80	5·9
ANGLESEY.								
Anglesey	365	314	—	—	31	7	13	5·5
Holyhead	527	465	—	—	40	9	13	4·2
BRECKNOCK.								
Brecknock	391	340	1	—	37	5	8	3·3
Builth	205	169	—	—	27	6	3	4·4
Crickhowell	741	600	—	—	72	12	57	9·3
Hay	257	216	—	—	29	7	5	4·7
CARDIGAN.								
Aberayron	283	250	—	—	16	—	17	6·0
Aberystwith	471	398	—	—	39	9	25	7·2
Cardigan	410	327	—	—	45	10	28	9·5
Lampeter	236	208	—	—	21	4	3	3·0
Tregaron	194	173	—	—	18	1	2	1·5
CARMARTHEN.								
Carmarthen	927	820	—	—	87	9	11	2·2
Llandilofawr	617	537	—	—	67	1	12	2·1
Llandovery	290	249	—	—	19	15	7	7·6
Llanelly	1,899	1,640	1	—	188	46	24	3·7
Newcastle-Emlyn	475	430	—	—	41	2	2	0·8

App. A. No. 1.

Lists of Vaccination Officers' Returns, 1891.

—	Returns, 1891.							
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Smallpox.	Died unvaccinated.	Vaccination postponed.	Remaining.	Objection not Enforced by Law, or considered fair Exemption, plus cases postponed past age of liability.
CARNARVON.								
Bangor and Beaumaris	964	858	3	—	90	12	31	8·1
Carnarvon	1,046	798	—	—	165	1	142	15·7
Conway	632	530	—	—	57	13	32	7·1
Pwllheli	542	486	—	—	39	9	8	5·1
DENBIGH.								
Llanrwst	343	287	—	—	28	10	8	7·2
Ruthin	267	238	—	—	25	2	2	1·5
Wrexham	2,196	1,874	2	—	221	47	40	4·4
FLINT.								
Asaph St.	672	579	2	—	66	7	18	3·7
Hawarden	488	381	—	—	23	12	72	17·2
Holywell	1,251	1,027	1	—	131	19	38	3·4
GLAMORGAN.								
Bridgend and Cowbridge	1,854	1,558	2	—	237	20	37	3·1
Cardiff	6,351	5,253	27	—	639	25	407	7·1
Gower	311	268	—	—	23	8	11	6·8
Merthyr Tydfil	4,056	3,097	5	—	548	195	91	4·3
Neath	2,189	1,876	3	—	251	16	35	2·2
Pontardawe	792	699	—	—	71	14	8	2·8
Pontypridd	6,441	5,238	—	—	849	120	219	3
Swansea	4,295	3,326	4	—	397	—	139	3·3
MERIONETH.								
Bala	132	110	—	—	18	4	—	8·0
Carnarvon	411	349	—	—	45	5	12	4·1
Dolgelley	325	275	—	—	40	2	1	3·1
Festiniog	755	641	—	—	91	15	4	5·0
MONTGOMERY.								
Forden	414	346	—	—	48	10	10	8·3
Llanfyllin	404	344	—	—	54	10	10	8·3
Machynlleth	287	258	—	—	20	2	7	3·1
Newtown and Llanidloes	579	504	—	—	46	7	20	4·7
PEMBROKE.								
Haverfordwest	913	731	—	—	105	30	47	8·4
Narberth	461	414	—	—	35	1	10	2·1
Pembroke	975	839	1	4	99	22	12	8·5
RADNOR.								
Knighton	332	294	—	—	27	14	62	24·8
Rhayader	177	146	—	—	21	—	12	8·5

No. 2.

List (alphabetically arranged) of 326 Unions inspected during the Year 1893, with reference to the Proceedings under the Vaccination Acts, 1867 and 1871, and an Account of the Awards certified by the Board as payable to the respective Public Vaccinators out of County Funds.

Union.	No. of Vaccination Districts in the Union.	No. of Public Vaccinators recommended for Award.	Range of Awards in each Union. Minimum.	Range of Awards in each Union. Maximum.	Total Sum awarded in each Union.	Medical Inspector.
			£ s. d.	£ s. d.	£ s. d.	
Abingdon	6	5	3 15 0	12 9 0	31 6 0	Dr. Sweeting.
Alcester	5	5	3 15 0	8 3 0	30 3 0	„ Wilson.
Alderbury	5	2	2 3 0	11 12 0	13 15 0	Mr. Royle.
Alresford	2	2	4 4 0	9 1 0	13 5 0	Dr. Sweeting.
Alverstoke	1	1	—	—	74 4 0	Do.
Amesbury	2	1	—	—	5 11 0	Mr. Royle.
Ampthill	4	4	6 14 0	11 9 0	33 12 0	Dr. BruceLow.
Andover	5	4	2 9 0	18 4 0	31 8 0	„ Sweeting.
Asaph, St.	5	5	5 12 0	12 8 0	42 17 0	Mr. Royle.
Aston	7	7	6 18 0	84 19 0	217 3 0	Dr. Wilson.
Atcham	7	6	3 7 0	43 12 0	74 12 0	„ Wheaton.
Atherstone	2	2	10 5 0	23 16 0	34 1 0	„ Wilson.
Auckland	9	7	8 3 0	24 18 0	124 7 0	„ Fletcher.
Austell, St.	7	3	4 3 0	26 14 0	47 9 0	„ Horne.
Bala	1	—	—	—	—	Mr. Royle.
Banbury	7	2	4 6 0	5 4 0	9 10 0	Do.
Bangor and Beaumaris	6	4	3 3 0	16 19 0	33 10 0	Do.
Barnet	5	4	3 12 0	14 17 0	36 11 0	Do.
Barton Regis	6	4	9 14 0	39 17 0	76 7 0	Do.
Beaminster	5	3	2 5 0	7 9 0	13 13 0	Dr. Fletcher.
Bedford	8	7	4 12 0	18 2 0	49 16 0	„ BruceLow.
Bethnal Green	2	2	21 12 0	62 11 0	84 3 0	„ Sweeting.
Beverley	5	4	2 3 0	26 14 0	33 14 0	„ BruceLow.
Bicester	7	4	1 6 0	14 2 0	20 4 0	Mr. Royle.
Biggleswade	6	5	3 9 0	9 15 0	34 7 0	Dr. BruceLow.
Birmingham	1	1	—	—	158 16 0	„ Airy.

App. A. No. 2.

Inspection of Public Vaccinators.

UNION.	No. of Vaccination Districts in the Union.	No. of Public Vaccinators recommended for Award.	Range of Awards in each Union. Minimum.	Range of Awards in each Union. Maximum.	Total Sum awarded in each Union.	Medical Inspector
			£ s. d.	£ s. d.	£ s. d.	
Blandford	4	2	3 12 0	5 17 0	9 9 0	Dr. Fletcher
Blything	8	6	5 8 0	12 3 0	52 13 0	,, Airy.
Bodmin	7	5	4 13 0	7 12 0	30 5 0	,, Horne.
Bolton	9	8	2 19 0	69 10 0	261 16 0	Mr. Evans.
Bosmere and Claydon	3	2	9 18 0	14 16 0	24 14 0	Dr. Airy.
Brackley	4	3	2 2 0	2 12 0	7 16 0	,, Horne.
Bradfield	5	5	5 12 0	10 11 0	41 19 0	,, Sweeting.
Bradford (Wilts)	3	—	—	—	—	Mr. Royle.
Bradford (Yorks)	4	3	24 2 0	41 16 0	99 13 0	Dr. Fletcher
Bramley	4	3	2 19 0	23 0 0	35 12 0	Do.
Bridgnorth	3	3	3 4 0	19 8 0	29 0 0	,, Wheaton.
Bridlington	4	2	1 12 0	5 3 0	6 15 0	,, BruceLow.
Bristol	1	1	—	—	14 12 0	,, Airy.
Brixworth	5	5	2 12 0	7 9 0	23 0 0	,, Horne.
Bromsgrove	5	4	1 7 0	25 15 0	59 5 0	,, Fletcher.
Bromyard	3	1	—	—	3 4 0	,, Wheaton.
Buntingford	2	2	2 12 0	5 3 0	8 0 0	Mr Royle.
Burnley	7	2	1 8 0	2 9 0	3 17 0	,, Evans.
Burton-on-Trent	8	5	7 4 0	69 18 0	141 11 0	Do.
Bury St. Edmunds	1	1	—	—	17 14 0	Dr. Airy.
Calne	1	1	—	—	12 11 0	Mr. Royle.
Camberwell	5	2	32 4 0	77 5 0	129 9 0	Dr. Sweeting.
Cambridge	1	1	—	—	45 1 0	,, Airy.
Camelford	2	2	6 15 0	12 2 0	18 17 0	,, Horne.
Cannock	6	3	1 0 0	27 6 0	36 12 0	Mr Evans.
Carnarvon	4	2	4 15 0	22 3 0	26 18 0	,, Royle.
Catherington	1	—	—	—	—	Dr Sweeting
Caxton and Arrington	4	2	5 19 0	7 6 0	13 5 0	,, Airy.
Cerne	3	3	1 5 0	8 7 0	17 10 0	,, Fletcher.
Chelsea	2	2	29 6 0	68 13 0	97 19 0	,, Sweeting.
Cheltenham	3	—	—	—	—	Mr Royle.
Chester-le-Street	4	3	10 9 0	40 12 0	67 7 0	Dr. Fletcher.
Chesterton	7	5	5 11 0	9 0 0	38 10 0	,, Airy.
Chippenham	6	4	3 9 0	18 9 0	46 12 0	Mr. Royle.
Chipping Norton	4	4	7 8 0	18 16 0	43 9 0	Do.
Chipping Sodbury	5	3	1 15 0	15 4 0	21 6 9	Do.

UNION.	No. of Vaccination Districts in the Union.	No. of Public Vaccinators recommended for Award.	Range of Awards in each Union. Minimum. £ s. d.	Range of Awards in each Union. Maximum. £ s. d.	Total Sum awarded in each Union. £ s. d.	Medical Inspector.
Chorley	5	5	12 15 0	22 8 0	87 4 0	Mr. Evans.
Christchurch	3	1	—	—	2 3 0	Dr. Sweeting.
Church Stretton	4	4	1 4 0	4 5 0	10 8 0	„ Wheaton.
Cirencester	5	5	0 17 0	8 6 0	25 0 0	Mr. Royle.
Cleobury Mortimer	2	2	8 3 0	9 12 0	17 15 0	Dr. Wheaton.
Clitheroe	5	4	3 19 0	13 6 0	27 19 0	Mr. Evans.
Clun	4	3	3 0 0	6 0 0	13 17 0	Dr. Wheaton.
Colchester*	1	1	—	—	58 15 0	„ Copeman.
Columb, St., Major	6	3	3 17 0	7 19 0	17 10 0	„ Horne.
Conway	3	3	11 12 0	15 12 0	40 0 0	Mr. Royle.
Cookham	3	2	1 18 0	16 7 0	18 5 0	Dr. Sweeting.
Corwen	3	2	4 5 0	8 11 0	12 16 0	Mr. Royle.
Cosford	5	4	4 2 0	9 6 0	26 13 0	Dr. Airy.
Coventry	1	1	—	—	1 9 0	Do.
Cricklade and Wootton Bassett.	3	3	4 7 0	9 5 0	22 6 0	Mr. Royle.
Darlington	5	3	3 18 0	56 13 0	65 3 0	Dr. Fletcher.
Daventry	6	5	0 19 0	6 14 0	20 12 0	„ Horne.
Devizes	6	6	1 4 0	14 18 0	39 14 0	Mr. Royle.
Dewsbury	12	8	1 9 0	17 13 0	74 7 0	Dr. Fletcher.
Dolgelley	5	5	2 5 0	9 5 0	22 13 0	Mr. Royle.
Doncaster	7	4	2 3 0	34 6 0	45 5 0	Dr. Fletcher.
Dorchester	6	5	1 3 0	16 1 0	32 8 0	Do.
Dore	3		—	—	5 9 0	„ Wheaton.
Drayton	5	5	1 18 0	12 1 0	28 13 0	Do.
Driffield	8	7	2 1 0	8 0 0	26 19 0	„ BruceLow.
Droitwich	6	5	1 1 0	10 15 0	36 5 0	„ Fletcher.
Droxford	4	2	6 3 0	6 15 0	12 18 0	„ Sweeting.
Dudley	8	7	12 8 0	40 17 0	205 1 0	„ Fletcher.
Durham	5	4	15 2 0	29 3 0	74 19 0	Do.
Dursley	3	3	2 15 0	5 19 0	14 2 0	Mr. Royle.

* Inspected in 1892.

App. A. No. 2.

Inspection of Public Vaccination.

UNION.	No. of Vaccination Districts in the Union.	No. of Public Vaccinators recommended for Award.	Range of Awards in each Union. Minimum.	Range of Awards in each Union. Maximum.	Total Sum awarded in each Union.	Medical Inspector.
			£ s. d.	£ s. d.	£ s. d.	
Easington	5	3	13 7 0	40 14 0	83 16 0	Dr. Fletcher.
East Hampstead	4	2	5 7 0	7 3 0	12 10 0	,, Sweeting.
Ellesmere	6	2	3 15 0	5 6 0	9 1 0	,, Wheaton.
Ely	5	2	4 14 0	12 17 0	17 11 0	,, Airy.
Evesham	5	5	1 16 0	21 7 0	41 19 0	,, Fletcher.
Exeter	1	1	—	—	26 15 0	,, Airy.
Falmouth	4	2	2 11 0	3 9 0	6 0 0	Dr. Horne.
Farcham	4	4	1 2 0	23 10 0	36 14 0	,, Sweeting.
Faringdon	4	3	3 8 0	8 2 0	18 0 0	Do.
Festiniog	5	3	4 9 0	13 12 0	24 10 0	Mr. Royle.
Foleshill	6	2	6 6 0	15 7 0	21 13 0	Dr. Wilson.
Forden	4	4	5 14 0	9 7 0	28 4 0	,, Horne.
Fordingbridge	2	2	9 16 0	11 2 0	20 18 0	,, Sweeting.
Fylde, The	5	3	4 1 0	10 17 0	29 6 0	Mr. Evans.
Garstang	3	2	5 10 0	7 2 0	12 12 0	Mr. Evans.
Gateshead	5	2	26 17 6	121 8 9	148 5 0	Dr. Fletcher.
George, St., East	1	1	—	—	60 4 0	,, Sweeting.
Germans, St.	6	4	3 14 0	11 19 0	34 14 0	,, Horne.
Gloucester	2	1	—	—	1 0 0	Mr. Royle.
Goole	4	3	3 5 0	23 5 0	30 19 0	Dr. Fletcher.
Gainsborough	7	2	6 19 0	9 3 0	16 2 0	,, Horne.
Hackney	4	3	14 7 0	27 16 0	69 0 0	Dr. Sweeting.
Hardingstone	3	3	3 1 0	4 19 0	12 12 0	,, Horne.
Hartismere	5	3	5 6 0	8 17 0	21 4 0	,, Airy.
Hartlepool	3	2	30 14 0	43 6 0	74 0 0	,, Fletcher.
Haslingden	6	6	6 3 0	29 18 0	107 16 0	Mr. Evans.
Havant	4	3	3 4 0	8 17 0	17 6 0	Dr. Sweeting.

UNION.	No. of Vaccination Districts in the Union.	No. of Public Vaccinators recommended for Award.	Range of Awards in each Union. Minimum.	Range of Awards in each Union. Maximum.	Total Sum awarded in each Union.	Medical Inspector.
			£ s. d.	£ s. d.	£ s. d.	
Hawarden	3	2	7 19 0	9 6 0	17 5 0	Mr. Royle.
Headington	2	2	14 3 0	80 19 0	95 2 0	Do.
Helmsley	2	—	—	—	—	Dr. Horne.
Helston	5	5	7 5 0	11 13 0	47 5 0	Do.
Hemsworth	4	4	2 0 0	15 13 0	39 17 0	„ Bruce Low.
Henley	6	3	2 10 0	16 9 0	33 14 0	Mr. Royle.
Hereford	4	4	9 9 0	40 10 0	71 12 0	Dr. Wheaton.
Hertford	5	3	3 14 0	14 17 0	23 4 0	Mr. Royle.
Highworth and Swindon	4	2	4 0 0	8 0 0	12 0 0	Do.
Hitchin	5	1	—	—	5 10 0	Do.
Holbeach	1	1	—	—	15 5 0	Dr. Fletcher.
Holywell	5	2	15 1 0	18 8 0	33 9 0	Mr. Royle.
Houghton-le-Spring	3	2	9 6 0	13 8 0	22 14 0	Dr. Fletcher.
Howden	4	2	3 6 0	3 6 0	6 12 0	„ BruceLow.
Hoxne	8	4	1 7 0	6 19 0	13 14 0	„ Airy.
Huddersfield	16	9	5 17 0	31 18 0	98 7 0	„ Fletcher.
Hungerford	5	2	1 11 0	7 10 0	9 1 0	„ Sweeting.
Hunslet	4	4	3 9 0	53 14 0	76 16 0	„ Fletcher
Huntingdon	5	5	4 15 0	12 14 0	37 11 0	„ Airy.
Ipswich	2	1	—	—	54 14 0	Dr. Airy.
Islington	5	2	57 17 0	68 13 0	126 10 0	„ Sweeting.
Ives, St.	5	3	4 16 0	7 12 0	18 10 0	„ Airy.
Keighley	4	3	0 13 0	3 10 0	5 16 0	Dr. BruceLow.
Kensington*	2	1	—	—	98 15 0	„ Sweeting.
Kettering	4	2	3 1 0	4 19 0	8 0 0	„ Horne.
Kidderminster	5	3	4 10 0	37 13 0	51 4 0	„ Fletcher.
King's Norton	7	7	1 5 0	83 5 0	188 11 0	Do.
Kington	5	5	1 2 0	8 11 0	23 10 0	„ Wheaton.
Kirkby Moorside	1	1	—	—	3 2 0	„ Horne.
Knaresborough	3	3	2 14 0	16 14 0	36 0	„ BruceLow.

* Inspected in 1892.

App. A. No. 2.

Inspection of Public Vaccination.

UNION.	No. of Vaccination Districts in the Union.	No. of Public Vaccinators recommended for Award	Range of Awards in each Union. Minimum.	Range of Awards in each Union. Maximum.	Total Sum awarded in each Union.	Medical Inspector
			£ s d	£ s d	£ s d	
Lambeth	5	5	14 11 0	86 19 0	277 14 0	Dr. Sweeting.
Lanchester	4	3	2 11 0	31 17 0	42 6 0	„ Fletcher.
Launceston	3	6	0 10 0	7 11 0	24 15 0	„ Horne.
Ledbury	2	2	9 0 0	10 0 0	19 0 0	„ Wheaton.
Leeds	7	7	0 17 0	73 8 0	152 18 0	„ Airy.
Leigh	3	3	18 16 0	58 11 0	115 15 0	Mr. Evans.
Leighton Buzzard	2	2	1 0 0	22 14 0	23 14 0	„ Royle.
Leominster	3	3	1 12 0	18 19 0	28 17 0	Dr. Wheaton.
Lewisham	5	4	6 9 0	24 14 0	59 5 0	„ Sweeting.
Lichfield	6	3	5 3 0	33 4 0	66 14 0	Mr. Evans.
Luton	3	2	7 16 0	9 5 0	17 1 0	Dr. Airy.
Liskeard	7	3	5 12 0	11 7 0	24 5 0	„ Horne.
Liverpool	3	1	—	—	41 17 0	„ Airy.
Llanfyllin	5	3	5 3 0	7 14 0	18 5 0	„ Horne.
Llanrwst	3	—	—	—	—	Do.
London, City of	2	2	6 18 0	11 1 0	17 19 0	„ Sweeting.
Ludlow	5	4	4 6 0	7 11 0	21 3 0	„ Wheaton.
Luton	3	3	2 0 0	3 8 0	7 8 0	Mr. Royle.
Lymington	4	2	4 14 0	8 3 0	12 17 0	Dr. Sweeting.
Machynlleth	4	2	5 5 0	6 8 0	11 13 0	Dr. Horne.
Madeley	4	3	5 0 0	24 12 0	39 10 0	„ Wheaton.
Malmesbury	4	2	1 11 0	5 11 0	7 2 0	Mr. Royle.
Malton	6	3	2 3 0	5 9 0	11 17 0	Dr. Horne.
Manchester	2	3	16 12 0	26 12 0	82 8 0	„ Airy.
Marlborough	2	1	—	—	5 0 0	Mr. Royle.
Martley	6	3	4 16 0	8 5 0	18 13 0	Dr. Fletcher.
Marylebone	2	2	59 8 0	87 1 0	146 9 0	„ Sweeting.
Melksham	2	2	15 9 0	27 1 0	42 10 0	Mr. Royle.
Mere	2	2	6 10 0	8 10 0	15 9 0	Do.
Mersden	3	3	1 16 0	6 2 0	13 5 0	Dr. Wheaton.
Middlesbrough	4	3	8 4 0	61 8 0	93 17 0	„ Horne.
Middlewich	2	1	—	—	13 16 0	„ Airy.
Milo End Old Town	2	2	26 2 0	57 18 0	84 0 0	„ Sweeting.
Milford and Lethingland.	3	3	6 16 0	67 17 0	101 7 0	„ Airy.

UNION.	No. of Vaccination Districts in the Union.	No. of Public Vaccinators recommended for Award.	Range of Awards in each Union. Minimum.	Range of Awards in each Union. Maximum.	Total Sum awarded in each Union.	Medical Inspector.
			£ s. d.	£ s. d.	£ s. d.	
Neots, St.	6	5	2 3 0	11 18 0	27 6 0	Dr. Airy.
Newbury	3	1	—	—	7 17 0	„ Sweeting.
Newcastle-on-Tyne	3	4	27 8 0	65 7 0	161 3 0	„ Airy.
Newcastle-under-Lyme	3	2	1 19 0	28 9 0	30 8 0	Mr. Evans.
Newent	3	3	5 10 0	7 7 0	20 0 0	„ Royle.
Newmarket	8	6	6 5 0	25 19 0	65 15 0	Dr. Airy.
Newport (*Mon.*)	9	1*	—	—	52 4 0	„ Fletcher.
Newport (Salop)	4	4	5 19 0	10 4 0	34 2 0	„ Wheaton.
Newtown and Llanidloes	4	3	5 2 0	16 7 0	29 16 0	„ Horne.
Nothallerton	4	2	2 8 0	3 11 0	5 19 0	Do.
Northampton	4	2	0 5 0	0 5 0	0 10 0	Do.
Northleach	4	5	1 6 0	5 18 0	16 16 0	Mr. Royle.
North Witchford	4	3	4 4 0	7 9 0	16 16 0	Dr. Airy.
Nuneaton	2	2	4 6 0	8 10 0	12 16 0	„ Wilson.
Ormskirk	6	6	9 8 0	42 16 0	131 13 0	Mr. T. W. Thompson.
Oswestry	5	5	4 9 0	32 9 0	69 3 0	Dr. Wheaton.
Oundle	4	1	—	—	8 4 0	„ Horne.
Ouseburn, Great	6	2	1 14 0	6 5 0	7 19 0	„ Fletcher.
Oxford	1	1	—	—	40 9 0	Mr. Royle.
Pancras, St.	1	1	—	—	162 1 0	Dr. Sweeting.
Pateley Bridge	2	2	0 7 0	10 3 0	10 10 0	„ Fletcher.
Patrington	5	3	0 14 0	2 9 0	5 3 0	„ BruceLow.
Penzance	5	2	9 11 0	17 6 0	26 17 0	„ Horne.
Pershore	5	3	6 12 0	14 12 0	29 3 0	„ Fletcher.
Peterborough	7	5	3 7 0	51 14 0	90 1 0	„ Horne.
Petersfield	4	3	4 12 0	12 4 0	24 14 0	„ Sweeting.
Pewsey	5	5	2 16 0	10 18 0	34 3 0	Mr. Royle.
Pickering	3	2	2 2 0	7 17 0	9 19 0	Dr. Horne.
Plomesgate	6	6	3 6 0	7 6 0	34 3 0	„ Airy.
Pocklington	6	3	2 5 0	5 1 0	10 4 0	„ BruceLow.
Pontefract	7	6	2 9 0	35 8 0	97 4 0	„ Sweeting.

* Specially inspected in 1893.

Apr. A. No. 2.

Inspections of Public Vaccinators.

UNION.	No. of Vaccination Districts in the Union.	No. of Public Vaccinators recommended for Award.	Range of Awards in each Union. Minimum.	Range of Awards in each Union. Maximum.	Total Sum awarded in each Union.	Medical Inspector.
			£ s. d.	£ s. d.	£ s. d.	
Poole	4	3	7 19 0	20 4 0	36 8 0	Dr. Fletcher.
Portsea Island	1	1	—	—	172 14 0	„ Sweeting.
Potterspury	4	3	1 4 0	17 12 0	21 8 0	„ Horne.
Preston	4	4	10 1 0	93 2 0	183 18 9	Mr. Evans.
Pwllheli	5	4	4 0 0	9 18 0	26 3 0	„ Rowe.
Reading	1	1	—	—	67 18 0	Dr. Sweeting.
Redruth	6	2	12 17 0	19 13 0	32 10 0	„ Horne.
Ringwood	1	1	—	—	20 2 0	„ Sweeting.
Ripon	4	3	2 1 0	17 8 0	22 15 0	„ Bruce Low.
Risbridge	5	3	3 7 0	19 19 0	28 2 0	„ Airy.
Romsey	4	3	3 1 0	22 3 0	25 4 0	„ Sweeting.
Ross	4	2	9 0 0	21 4 0	30 4 0	„ Wheaton.
Royston	6	4	4 8 0	12 4 0	26 9 0	Mr. Rowe.
Rugby	3	3	2 8 0	5 17 9	29 11 9	Dr. Wilson.
Ruthin	3	—	—	—	—	„ Horne.
Saddleworth	1	1	—	—	13 8 0	Dr. Bruce Low.
Salford	4	3	8 15 0	31 16 0	65 7 0	„ Airy.
Samford	4	3	4 4 0	12 2 0	25 9 0	Do.
Scarborough	6	3	4 3 0	6 7 0	14 18 0	„ Horne.
Sculcoates	6	4	1 19 0	96 10 0	155 11 0	„ Bruce Low.
Sedburgh	2	2	3 3 0	3 17 9	7 0 0	Do.
Sedgefield	4	3	14 14 0	16 1 6	46 11 6	„ Fletcher.
Seisdon	4	3	5 4 0	9 1 0	21 17 0	Mr. Evans.
Selby	4	4	1 0 0	19 19 0	29 9 6	Dr. Fletcher.
Shaftesbury	3	2	5 2 0	12 6 0	17 8 0	Do.
Sheffield	6	6	11 16 0	37 10 6	167 11 6	Airy.
Shefnal	4	3	6 9 0	9 6 0	23 6 0	„ Wheaton.
Shipston-on-Stour	5	5	3 18 0	13 10 6	35 18 0	„ Fletcher.
Skipton	3	2	3 7 0	6 15 0	10 2 0	Do.
Skirlaugh	3	1	—	—	6 1 0	„ Bruce Low.

UNION.	No. of Vaccination Districts in the Union.	No. of Public Vaccinators recommended for Award.	Range of Awards in each Union.		Total Sum awarded in each Union.	Medical Inspector.
			Minimum.	Maximum.		
			£ s. d.	£ s. d.	£ s. d.	
Solihull	4	4	3 16 0	14 5 0	29 14 0	Dr. Wilson.
Southam	4	3	2 7 0	7 18 0	15 17 0	Do.
South Shields	3	2	66 6 0	81 5 0	147 11 0	„ Fletcher.
Stafford	4	4	5 4 0	21 5 0	56 12 0	Mr. Evans.
Stockbridge	2	2	9 7 0	10 2 0	19 9 0	Dr. Sweeting.
Stockton	3	2	11 4 0	37 19 0	49 3 0	„ Fletcher.
Stokesley	4	4	3 19 0	7 11 0	24 5 0	„ Horne.
Stoke-upon-Trent	5	5	14 6 0	102 2 0	245 2 0	Mr. Evans.
Stone	4	2	16 8 0	16 14 0	33 2 0	Do.
Stourbridge	7	4	6 16 0	40 6 0	91 14 0	Dr. Fletcher.
Stow	7	5	2 0 0	10 1 0	32 17 0	„ Airy.
Stow-on-the-Wold	2	1	—	—	5 9 0	Mr. Royle.
Stratford-on-Avon	7	5	2 1 0	13 1 0	29 5 0	Dr. Wilson.
Stratton	2	—	—	—	—	„ Horne.
Stroud	6	4	5 13 0	10 5 0	31 8 0	Mr. Royle.
Sturminster	4	2	5 3 0	11 4 0	16 7 0	Dr. Fletcher.
Sudbury	7	6	1 11 0	18 0 0	54 12 0	„ Airy.
Sunderland	5	4	23 4 0	57 17 0	159 7 0	„ Fletcher.
Tadcaster	5	4	0 9 0	15 11 0	34 7 0	Dr. Fletcher
Tamworth	3	2	27 11 0	28 19 0	56 10 0	Mr. Evans.
Teesdale	5	3	6 3 0	10 13 0	24 1 0	Dr. Fletcher.
Tenbury	2	1	—	—	8 16 0	Do.
Tetbury	2	1	—	—	6 4 0	Mr. Royle.
Tewkesbury	4	—	—	—	—	Do.
Thame	6	6	1 7 0	10 10 0	36 1 0	Do.
Thingoe	8	8	1 7 0	13 2 0	46 14 0	Dr. Airy.
Thirsk	6	6	1 2 0	7 10 0	15 5 0	„ Horne.
Thornbury	4	2	1 12 0	11 7 0	12 19 0	Mr. Royle.
Thorne	5	2	2 3 0	2 6 0	4 9 0	Dr. Fletcher.
Thrapston	5	1	—	—	3 14 0	„ Horne.
Tisbury	3	2	5 5 0	7 19 0	13 4 0	Mr. Royle.
Todmorden	2	2	4 2 0	10 1 0	14 3 0	Dr. Fletcher.
Towcester	4	2	4 16 0	6 1 0	10 17 0	„ Horne.
Toxteth Park	2	2	15 14 0	19 19 0	35 13 0	„ Airy.
Truro	7	4	2 8 0	11 10 0	24 7 0	„ Horne.

App. A. No. 2

Inspection of Public Vaccination

UNION.	No. of Vaccination Districts in the Union.	No. of Public Vaccinators recommended for Award	Range of Awards in each Union.		Total Sum awarded in each Union.	Medical Inspector.
			Minimum.	Maximum.		
			£ s. d.	£ s. d.	£ s. d.	
Upton-on-Severn	6	4	1 4 0	17 14 0	31 11 0	Dr. Fletcher.
Uttoxeter	5	2	5 1 0	5 8 0	10 9 0	Mr Evans.
Wakefield	6	4	7 7 0	51 5 0	110 15 0	Dr Fletcher.
Wallingford	3	2	11 5 0	13 3 0	24 8 0	„ Sweeting.
Walsall	4	3	21 1 0	37 6 0	80 6 0	Mr. Evans.
Wandsworth and Clapham.	8	4	11 17 0	48 4 0	111 15 0	Dr. Sweeting.
Wangford	2	2	10 10 0	28 13 0	39 3 0	„ Airy.
Wantage	6	6	4 7 0	10 15 0	43 17 0	„ Sweeting.
Ware	8	7	0 6 0	11 6 0	39 4 0	Mr. Royle.
Wareham and Purbeck	7	2	7 13 0	9 18 0	17 11 0	Dr. Fletcher.
Warminster	5	5	2 19 0	11 5 0	33 19 0	Mr. Royle.
Warrington	3	3	12 8 0	184 16 0	245 19 0	„ Evans.
Warwick	3	2	13 3 0	21 11 0	34 14 0	Dr. Wilson.
Watford	4	3	4 5 0	17 3 0	31 1 0	Mr. Royle.
Weardale	5	4	0 16 0	8 3 0	16 11 0	Dr. Fletcher.
Wellingborough	5	3	0 10 0	1 12 0	2 16 0	„ Horne.
Wellington (Salop)	3	3	7 0 0	30 9 0	64 16 0	„ Wheaton.
Wem	4	2	6 9 0	6 11 0	13 0 0	Do.
Weobley	3	1	—	—	6 4 0	Do.
West Bromwich	5	4	28 4 0	54 14 0	170 8 0	Mr. Evans.
Westbury-on-Severn	4	4	3 13 0	11 9 0	30 2 0	„ Royle.
Westbury and Whorwelsdown.	4	4	2 19 0	15 4 0	28 5 0	Do.
West Derby	7	7	11 10 0	65 3 0	194 11 0	Dr. Airy.
Wetherby	6	1	—	—	6 3 0	„ Fletcher.
Weymouth	6	5	3 1 0	14 1 0	41 4 0	Do.
Wharfedale	4	3	6 3 0	16 16 0	23 19 0	Do.
Wheatenhurst	2	2	1 19 0	2 1 0	4 0 0	Mr. Royle.
Whitby	4	2	4 17 0	13 11 0	18 8 0	Dr. Horne.
Whitchurch (Salop)	3	3	1 16 0	13 17 0	26 5 0	„ Wheaton.
Whittlesey	2	1	—	—	2 7 0	„ Airy.
Wigan	10	4	11 1 0	75 7 0	122 2 0	Mr Evans.
Wilton	4	3	5 10 0	11 3 0	24 10 0	„ Royle.

UNION.	No. of Vaccination Districts in the Union.	No. of Public Vaccinators recommended for Award.	Range of Awards in each Union. Minimum.	Range of Awards in each Union. Maximum.	Total Sum awarded in each Union.	Medical Inspector.
			£ s. d.	£ s. d.	£ s. d.	
Wimborne and Cranborne.	4	2	14 1 0	18 12 0	32 13 0	Dr. Fletcher.
Winchcomb - -	2	2	5 2 0	10 11 0	15 13 0	Mr. Royle.
Windsor - - -	3	1	—	—	30 6 0	Dr. Sweeting.
Wisbeach - - -	14	6	2 3 0	16 5 0	39 14 0	„ Airy.
Witney - - -	4	2	14 0 0	19 18 0	33 18 0	Mr. Royle.
Woburn - - -	2	1	—	—	8 9 0	Do.
Wokingham - -	4	3	3 14 0	7 4 0	16 0 0	Dr. Sweeting.
Wolstanton and Burslem	3	3	50 5 0	61 12 0	168 18 0	Mr. Evans.
Wolverhampton - -	5	1	—	—	40 5 0	Do.
Woodbridge - -	4	4	4 12 0	15 6 0	44 13 0	Dr. Airy.
Woodstock - -	4	1	—	—	8 15 0	„ Royle.
Woolwich - -	4	2	24 5 0	75 8 0	99 13 0	„ Sweeting.
Worcester - -	1	1	—	—	43 6 0	„ Fletcher.
Wrexham - - -	5	4	6 3 0	43 11 0	69 19 0	„ Horne.
York - - -	6	4	2 17 0	125 16 0	140 19 0	„ BruceLow.
Total - -	1,429	992	—	—	14,286 8 0	

App. A. No. 3.

National Vaccine [illegible]

No. 3.

Statistics of the National Vaccine Establishment and Educational Vaccination Stations.

I.—Staff at end of 1893.

N.B.—The Stations named in *italics* are Educational Vaccination Stations authorised by the Local Government Board.

Description of Vaccinator.	Name of Vaccinator.	Vaccination Stations.	Days and Hours of Attendance.
Vaccinators supplying lymph for the public service and salaried from the Parliamentary grant.	1. Dr. R. Cory	*Surrey Chapel* -	Tues., Thurs.; 2.
	2. Mr. Joseph Loane	*Tottenham Court Chapel.*	Mon., Wednes.; ;
Parochial and other Vaccinators not salaried from the Parliamentary grant, but contributing lymph at a fixed rate of payment.	1. Mr. Ellis S. Guest	*Manchester* -	Monday; 2.
	2–6. Dr. Edmund Robinson.	*Birmingham* -	Monday - } 11. Tuesday - } Wednesday } Wednesday; 2. Thursday; 11.
	7. Mr. N. E. Roberts	*Liverpool* -	Tuesday; 1.
	8. Mr. E. L. Webb	*Pimlico* -	Thursday; 10.
	9 Mr. J. Hawthorn	*Newcastle-on-Tyne.*	Wednesday; 3.
	10. Mr. E. L. Webb	Westminster -	Tuesday; 10.
	11–12. Mr. E. C. Greenwood	*Marylebone* -	Tuesday; 2. Wednesday; 10.
	13. Mr. J. Loane	*Whitechapel* -	Wednesday; 11.
	14. Mr. Frederick Holmes	*Leeds* -	Tuesday; 2.30.
	15. Dr. Edward Lynes	Coventry -	Tuesday; 12.
	16–17. Dr. Hugh Thomson	*Glasgow* -	Monday; 2. Mon., Thurs.; 12.
	18. Mr. J. F. Staines	*Endell Street* -	Tuesday; 10.
	19. Mr. W. Skinner	*Sheffield* -	Tuesday; 3.
	20. Dr. A. C. Clarke	Salford -	Thursday; 2.
	21. Dr. G. A. Miskin	Waterloo -	Tuesday; 2.
	22. Dr. J. B. Buist	*Edinburgh* -	Thursday; 3.
	23. Dr. R. Cory	*St. Thomas's Hosp.*	Wednesday; 11.30.
	24. Mr. Wm. McLennan	*Glasgow West* -	Monday; 1.
	25. Dr. William A. Budd	*Exeter* -	Thursday; 3.
Teachers of Vaccination not supplying lymph.	Dr. W. Husband	*Edinburgh* -	Wednes., Sat.; 12
	Mr. H. Lawrence	*Bristol* -	Wednesday; 10.
	Mr. V. A. Jaynes	*Horsleydown* -	Wednesday; 3
	Dr. A. N. Montgomery	*Dublin* -	Tues., Fri.; 10.
	Dr. R. Cory	*Cambridge* -	Friday; 11.

II.—Animal Vaccine Station.

National Vaccine Establishment.

The Animal Vaccine Station is at 95, Lamb's Conduit Street, where Dr. R. Cory and Mr. T. S. Stott attend for the Vaccination of Children on Tuesdays and Thursdays, at 10.30 a.m.

III.—Sources and Amount of Lymph Supply in 1893.

N.B.—The Stations named in *italics* are Educational Vaccination Stations authorised by the Local Government Board.

Description of Vaccinator.	Vaccination Stations.	Number of Vaccinations performed at the Stations respectively.		Number of Charges of Lymp supplied from the Stations respectively.	
		Primary.	Re-vaccinations.	Charged Ivory Points.	Charged Tubes each estimated as equal to 10 Ivory Points.
Vaccinators salaried from the Parliamentary grant.	1. *Surrey Chapel*	163	19	1,040	—
	2. *Tottenham Court Chapel.*	319	36	—	141
	Total -	482	55	1,040	141
Parochial and other Vaccinators not salaried from the Parliamentary grant, but contributing lymph at a fixed rate of payment.	1. *Manchester* -	924	103	—	145
	2–6. *Birmingham* -	3,817	2,350	—	1,063
	7. *Liverpool* -	490	86	—	118
	8. *Pimlico* - -	358	21	—	5
	9. *Newcastle-on-Tyne.*	536	18	—	141
	10. Westminster -	537	25	—	5
	11–12. *Marylebone*	1,039	347	—	37
	13. *Whitechapel* -	2,038	—	—	624
	14. *Leeds* - -	697	5	—	—
	15. Coventry -	45	9	—	—
	16–17. *Glasgow* -	1,240	38	—	48
	18. *Endell Street* -	204	20	—	105
	19. *Sheffield* - -	649	5	—	—
	20. Salford - -	296	11	—	—
	21. Waterloo -	1,407	1	—	2,103
	22. *Edinburgh* -	425	16	—	—
	23. *St. Thomas's Hospital.*	211	12	—	—
	24. *Glasgow West* -	574	50	—	14
	25. *Exeter** - -	180	10	—	7
	Total -	15,667	3,127	—	4,415
	Grand Total -	16,149	3,182	1,040	4,556

* For seven months only.

III.—Sources and Amount of Lymph—*continued.*

During the year, additional supplies (to the extent of 3,274 charged tubes) were obtained from the following gentlemen:—

Dr. T. N. Orchard, Pendleton.
Mr. J. Bark, Kirkdale.
Dr. F. Cadell, Edinburgh.
Mr. A. Meeson, Toxteth Park.
Dr. R. F. Cook, Gateshead.
Dr. G. A. Miskin, Kennington.
Mr. H. E. Hackett, Gorton.

IV.—Distribution of Human Lymph, 1893.

Number of applications:	
From Medical Practitioners in England and Wales	4,071
„ „ „ Scotland	157
„ the Army	1
„ the Navy and from the Emigration Department	39
„ India and the Colonies	36
„ Diplomatic and other Foreign Services	13
Supplies sent out:—	
Charged ivory points	1,020
„ capillary tubes	6,787

V.—Distribution of Calf-Lymph, 1893.

Number of applications	2,797
Supplies received:—	
Charged ivory points	18,981
„ capillary tubes	76
Supplies sent out:—	
Charged ivory points	16,176
„ capillary tubes	

No. 4.

Report on the Operations of the Animal Vaccine Station at Lamb's Conduit Street during the year 1893–94; by Dr. Cory.

During the year 1st April, 1893 to 31st March, 1894, 276 calves were received at Lamb's Conduit Street. Of these (males 194, females 82) were vaccinated for the purposes, of the station, other four were rejected as unfit for vaccination purposes. The aggregate weight on reception at Lamb's Conduit Street of the 276 calves was, males 56,365 lbs., females 24,941 lbs. On dismissal from the station their weights were respectively, males 61,039 lbs., females, 27,013 lbs., so that during retention for vaccination purposes calves of both sexes gained considerably in weight males by an average of 24·09 lbs., females by an average of 25·27 lbs.

Of the above calves, 264 were vaccinated with lymph directly derived from other calves, and 12 were vaccinated with calf lymph which had been stored. As usual, vaccinations performed with stored lymph proved much less successful than the others; 19,997 insertions in 264 calf to calf operations produced 18,596 vesicles, or 93·00 per cent.; and 690 in 12 stored lymph operations produced 535 vesicles, or 77·54 per cent. No material difference in the result of calf to calf vaccinations was observed whether the lymph used was from calves vaccinated 72, 96, or 120 hours previously; irrespective of interval in the above sense, the rate of insertion success was practically 93 per cent. The average temperature taken in the rectum of the 82 female calves was 102·39 before vaccination, and 103·00 five days after vaccination. The average temperature of the 194 males before vaccination was 102·58, and 103·34 five days after vaccination.

Primary Vaccinations.—During the year 7,693 persons received primary vaccinations at the station, five separate insertions of lymph being made in each instance. Of these persons, 3,897 were male, 3,796 females. All but 54 of the 7,590 primary vaccinations which returned for inspection succeeded at the first attempt and in no case was a third attempt at vaccination requisite. The amount of insertion success obtained by each of three several operators was as follows. Of 17 persons primarily vaccinated by Mr. Stott, one failed to return for inspection. Of the remaining 16, nine were, on examination, found to have taken in five places, one in four, four in three, one in two, one in one. Of 991 persons primarily vaccinated by Dr. Savory, acting for Mr. Stott or myself in the absence of one or other of us, 15 failed to return for inspection, and two were vaccinated for the cure of nævi. Of the 974 remaining, 816 were found to have taken in five places, 56 in four, 34 in three, 19 in two, 32 in one, and 17 failed on the first attempt. Dr. Savory's success therefore was 91·91 per cent. Of 6,685 persons primarily vaccinated by myself, 87 who failed to return for inspection and other 29 are not taken into account in these statistics.* Of the 6,569 remaining, 5,942 were found to have taken in five places, 312 in four, 139 in three, 74 in two, 65 in one only, while in 37 cases vaccination proved unsuccessful on the first trial, an insertion success rate of 96·17 per cent.

Re-vaccinations.—These during the year numbered 598. Mr. Stott performed 7, Dr. Savory 45, and I myself 546. Of these latter 407 were successful in five places, 48 in four, 11 in three, 4 in two, 11 in one

* Of these 29, 11 were operated on for the cure of nævi; and of the 18 remaining 4 were infants vaccinated with lymph taken at a very early stage of the calf-vesicle, and 14 were infants vaccinated with stored calf-lymph from French or outside sources.

and 20 were unsuccessful. Other 45 did not return for inspection. My insertion success rate therefore in revaccinations was 90·98 per cent. and Dr. Savory's 93·49 per cent.

In all 74 cases returned to the station after "inspection" on account of some abnormal course of their vaccinations. In the vast majority of cases the abnormality consisted of sore arm, referable almost always to ignorant treatment of the vesicles or of the scab, in spite of the printed directions on the backs of the cards that are given to the persons in charge of each infant vaccinated. For the rest there were six cases of transient eruption, four cases of axillary abscess following sore arm, and six cases of erysipelas also complicating sore arm.

Two deaths were heard of as occurring shortly after vaccination. Elsie L. G—, who was vaccinated on the 4th July, is said to have died on the 24th July of exhaustion followed by convulsion. Arthur V. F—, who was vaccinated on the 17th October, 1893, died of erysipelas on the 7th November, 1893.

No. 5.

Abstract of Medical Inspections made in 1893 with regard to the Incidence of Disease on particular places, and to questions concerning Local Sanitary Administration.

1. Alton Registration District (Southants); population (1891), 15,146; Dr. Deane Sweeting.

Sanitary Authorites: Alton U. and R.*

Ground of Inquiry: Diphtheria. Registrar-General's Returns.

Chief Facts reported by Inspector: Alton U.—There were 14 cases of diphtheria notified between April 29th and May 8th, of which eight proved fatal. Four families invaded, in three of which infection was directly, in the other indirectly, referable to Chawton, in the rural district of Alton. Spread entirely by personal means. No connexion with insanitary circumstances. Suspicious deaths from variously termed throat affections in Alton in previous years. Hospital provision altogether unsatisfactory and inadequate.

Alton R.—There were 45 cases of diphtheria notified from April 1st to July 28th, of which 12 proved fatal. Confined chiefly to Chawton parish, and extended thence to five other parishes. Many minor cases of sore throat bridging over incidence of notified diphtheria. Origin of first case at Chawton not determinable. Disease spread chiefly by school assemblage. Chawton school found defective in ventilation and in excrement disposal. No definite connexion with insanitary surroundings; but water supply inadequate, and excrement removal imperfect throughout the district. School closure resorted to; but tardily at first. No proper hospital provision. A farmhouse extemporised as a hospital.

2. Amlwch (Anglesey); population (estimated), 2,500; Mr. E. Evans.

Sanitary Authority: Anglesey R.

Ground of Inquiry: Enteric fever. Registrar-General's Returns.

Chief Facts reported by Inspector: Localised outbreak of enteric fever occurring during first four months of the year on the outskirts of the town at Amlwch Port. Disease spread from an imported case amongst attendants and visitors in the absence of proper nursing, isolation, and disinfection. No common water, milk or food supply, and no drainage.

Water supply of town from unprotected dip wells at an unreasonable distance from dwellings. No proper system of sewerage. District entirely neglected by Sanitary Authority.

3. Ashton-in-Makerfield (Lancashire); population (1891), 13,379; Dr. Wheaton.

Sanitary Authority: Ashton-in-Makerfield U.

Ground of Inquiry: Prevelance of "fever." Reports of Medical Officer of Health.

* Throughout this abstract "U." denotes "Urban Sanitary Authority," and "R.," "Rural Sanitary Authority."

Chief Facts reported by Inspector: The "fever" in question found to be for the most part enteric fever, although it was impossible to exclude the presence of a few cases of typhus fever. The enteric fever outbreak due in all probability to specific contamination of the soil around houses by defective house drains, which, together with personal infection, accounted for the peculiar limitation of the fever to certain localities. Hospital provision, available and made use of to a certain extent. Water supply subject to pollution up to 30th July 1892 from the use of privy manure on the gathering ground in the neighbourhood of the reservoir. Sewers, very defective, containing a large amount of deposit, and in some instances "blocked." Condition of houses, in places very unwholesome, deficient privy accommodation.

4. ATHERSTONE (WARWICK); population (1891), 4,991; Dr. Wheaton.

Sanitary Authority: Atherstone R.

Ground of Inquiry: Enteric fever outbreak. Report of Medical Officer of Health.

Chief Facts reported by Inspector: Outbreak of enteric fever, almost entirely confined to a limited area in the town of Atherstone. Outbreak not due to excrement disposal, sewerage, drainage, or milk supply; but to the introduction nightly into the town water mains for a period of eight weeks of an extraneous water supply, which was subject to pollution. The localisation of the fever outbreak explained by the peculiar distribution of the water mains, owing to which the suspected water was almost entirely consumed within the area to which the fever in question was almost entirely confined. The subsequent prevalence and extension of the disease in part due to infection from privy middens, also to contamination of water supply by residue of suspected water remaining in the mains, and continued consumption of the same water, which was obtained from a public tap.

5. BREEDY BUTTS FARM; (LANCASHIRE); Dr. Maclean Wilson.

Sanitary Authority: Fylde R.

Ground of Inquiry: Diphtheria. Report of Medical Officer of Health.

Chief Facts reported by Inspector: Household of 13 persons; 10 attacked by diphtheria; 7 died. Those first attacked attended school where sore throats were prevalent amongst scholars, some of which had been diphtheritic. Insanitary state of premises. No evidence of lower animals suffering.

6. BRENT RIVER (MIDDLESEX); Dr. Copeman.

Sanitary Authorities: (Middlesex, portion only of river surveyed.) Brentford R.; Ealing U.; Hanwell R.; Hendon R.; Willesden U.

Ground of Inquiry: Foul condition of river bed. Complaints from private residents.

Chief Facts reported by Inspector: Water from normal sources of river diverted by Regent's Canal Company. Effluent from Willesden sewage farm therefore practically forms source of river at present time; other large farms also discharge effluent

into lower reaches of river. Where river passes below Grand Junction Canal are vast heaps of London refuse, drainage from which passes into Brent. Some houses and manufacturing premises also drain to river.

Bed of river has been torn up by sudden discharge of water from "Welsh Harp" when sluices are opened, and putrescible matter has collected in considerable quantity in pits thus formed at various points.

7. Brownhills U.S.D. (Staffordshire); population (1891), 13,703; Mr. T. W. Thompson.

Sanitary Authority: Brownhills U.

Ground of Inquiry: To ascertain the action taken by the Urban Sanitary Authority for improving the general sanitary condition of the district, since Mr. Thompson's previous inspection in 1892.

Chief Facts reported by Inspector as to recent action by the Urban Sanitary Authority:—Comprehensive scheme on foot for sewering the localities of Walsall Wood, Shelfield, High Heath, and Clayhanger. Considerable improvement in eave-spouting of dwellings. Some improvement in privy and ash-pit accommodation, and apparently also in scavenging. Water of the South Staffordshire Water Works Company laid on to 128 additional houses and two schools, but beyond this no important improvement in the water supply of the district yet effected. Some action taken with a view to securing the extension of the company's mains to Walsall Wood but so far without success, though the hope is entertained that such extension will be carried out in the near future. The Infectious Disease (Notification) Act, 1889, adopted, and land purchased for purpose of an isolation hospital. General sanitary administration apparently of a more active character.

8. Chester-le-Street (Durham); population (1891), 4,864; Dr. Maclean Wilson.

Sanitary Authority: Chester-le-Street R.

Ground of Inquiry: Enteric Fever. Report of Medical Officer of Health.

Chief Facts reported by Inspector: Sudden outbreak of enteric fever, followed after a short interval by another equally sudden. Sufferers in both almost entirely persons using one public water supply, which at the commencement of both outbreaks was contaminated by enteric fever discharges passing into the stream forming the source of supply, and which was imperfectly filtered. In several cases infection spread by insanitary surroundings.

9. Derry Hill (Wilts); population (estimated), 1,000; Dr. Horne.

Sanitary Authorities: Calne R. and Chippenham R.

Ground of Inquiry: Diphtheria. Local complaints.

Chief Facts reported by Inspector: Prevalence of diphtheria for some years in the locality. No data showing to what extent until 1890, in which year both Sanitary Authorities adopted the Infectious Disease (Notification) Act. Succession of cases broken apparently only by short intervals from

autumn 1890 to spring of 1893. Evidence of concurrent throat illness. Incidence of attack markedly on children, especially of school-going age. Absence of data corroborative of local views attributing the disease to unwholesome conditions. Evidence pointing to children having suffered from diphtheria in mild and unrecognised form whilst regularly attending school. Absence of any sewerage system. Crude and insanitary methods of excrement and dust removal. Water supply open to suspicion.

10. Great Tey (Essex); population (1891), 661; Dr. Copeman.

Sanitary Authority: Lexden and Winstree R.

Ground of Inquiry: Diphtheria. Local complaints.

Chief Facts reported by Inspector:—Disease introduced to village probably from neighbouring district where for years past diphtheria has been endemic, with subsequent extensive spread in virulent form on the virgin soil afforded by the inhabitants; no record of previous appearance of the disease here having been available. Diphtheria as such apparently preceded by cases of anomalous throat illness. School attendance evidently a factor in the spread of disease. No hospital provision available in district. Water supply derived mainly from surface ponds in clay soil. Sewer in the "street" about 100 yards long, near mouth of which it is joined by open ditch which receives drainage of privies and household slops, &c., from considerable portion of village. Dwellings generally damp and in bad repair.

11. Hinckley Urban and Rural Sanitary Districts (Leicester): population (1891), 20,699; Dr. Wheaton.

Sanitary Authorities: Hinckley U. and R.

Ground of Inquiry: Diphtheria. Registrar-General's Returns.

Chief Facts reported by Inspector: Hinckley U.:—Outbreak of diphtheria commencing in September 1893, preceded by prevalence of measles with throat complications in 1892, and scarlet fever with throat complications in 1893. The origin of the outbreak could not be attributed to any specially insanitary conditions. The spread of the diphtheria due to personal infection, especially through attendance at schools. Co-existing prevalence of certain affections of the throat, nose, and mouth. Absence of isolation provision, disinfection, and notification of infectious disease. Sewers, very defective in many instances containing a large quantity of deposit. House drainage defective. Excrement disposal, principally by privy middens; unwholesome dwellings; absence of supervision of slaughter-houses, dairies, and bakehouses.

Hinckley R.—Outbreaks of diphtheria in the villages of Stony Stanton, Stoke Golding, Earl Shilton, and Burbage. In the case of Stony Stanton (population 1,226) the disease appeared early in 1893, and was preceded by measles and scarlet fever with throat complications in the latter part of 1892, and beginning of 1893. The spread of the disease in Stony Stanton due to personal infection, chiefly through attendance at the village school. The disease at Stoke Golding (population, 619), Earl Shilton (population, 2,594), and Burbage (population, 1,896), appeared to have been

introduced by infection contracted at fairs; and to have spread by personal contagion. Affections of the throat, mouth, and nose, similar to those found to prevail in the Hinckley Urban Sanitary District, existed among children in the villages in which diphtheria had appeared; but appeared to be absent in the other villages in the district with one exception, that of Higham. Absence of isolation provision. Water-supply from wells, with the exception of Stony Stanton; part of which village is supplied with water from a quarry which is filtered before distribution. Excrement disposal effected by midden privies. Sewage discharged into watercourses. House drainage defective in the villages of Wolvey, Sharnford, and Higham, in which villages also there are many unwholesome dwellings.

12. Leyton (Essex); population (estimated), 63,000; Dr. Deane Sweeting.

Sanitary Authority: Leyton U.

Ground of Inquiry: Alleged Milk-Scarlatina. Report of the Leyton Urban Sanitary Authority.

Chief Facts reported by Inspector: Rise of notifications of scarlatina early in September, after sustained prevalence of the disease. Disproportionate incidence on customers of a particular dairy in Leyton. Seven cases of scarlatina just previously at a farm at Ongar supplying this Leyton dairy; alleged "Bovine Scarlatina" amongst the cows there. This latter denied, and conflicting veterinary certificates given. Milk from the Ongar farm stopped by the Leyton Sanitary Inspector from September 7th until the end of October; but scarlatina continued to be notified in the Leyton Urban Sanitary District. The Leyton Dairy found to be supplied from four other farms besides Ongar: no scarlatina known at these other farms. Speciality of distribution of milk from any of these five farms over any part of the area supplied by the dairy not determinable. Hence, impossible to correlate the increased incidence of early September with milk from the particular Ongar farm. All precautions against infection of milk taken at this farm during the prevalence of scarlatina. The Leyton dairy clean and well-arranged.

13. Pirbright, Normandy, Stoke (Extra-Urban), and Merrow (Surrey); Dr. Horne.

Sanitary Authorities: Guildford R. and Farnham R.

Ground of Inquiry: Diphtheria. Registrar-General's Returns.

Chief Facts reported by Inspector: Pirbright and Normandy:—Two separate outbreaks at Pirbright. Introduction of infection from London. Further and separate infection of district from Normandy. Spread of the disease by personal infection in both outbreaks.

Very general prevalence of "bad throats" antecedent to, and concurrently with, the first recognised case of diphtheria at Normandy. "Bad throats" frequent sequelæ of measles. Spread of diphtheria by personal infection both among children attending school and to adults in relation with infected households.

Stoke (Extra-Urban) and Merrow:—Greater incidence of diphtheria on extra-urban Stoke than upon Merrow. "School influence" concerned in the dissemination of diphtheria. Stoke Hill school chiefly concerned during January. Closure followed by almost complete cessation of invasion of houses sending children to it. Re-opening possibly responsible for spread of disease during March, April, and May. Serious development of diphtheria in July among children having relation with Stoughton Board School. Closure of schools followed by marked decadence of diphtheria extension. Limitation of spread of disease so long as school with a comparatively small attendance was implicated. Corresponding increase of disease when school with larger attendance became involved. Absence of house-to-house inquiries in vicinity of infected houses. Isolation practised in suitable cases. Disinfection of premises and clothing carried out. No methodical examination of children on re-assembly of scholars.

14. Pocklington (Yorks, E.R.); population (1891), 2,577; Mr. Evans.

Sanitary Authority: Pocklington U.

Ground of Inquiry: Enteric fever. Registrar-General's Returns.

Chief Facts reported by Inspector: Forty-three families invaded by enteric fever between April and October 1893; 63 cases and 11 deaths. Water-supply chiefly from shallow wells in the town; households using public supply from source outside the town also invaded. Fouling of air and soil by defective sewers, untrapped drains in direct connexion with interior of dwellings, "cesspools," and leaky privy middens in confined backyards. Infected excreta mixed with chloride of lime and deposited in middens, drains, and "beck." No isolation hospital; no disinfecting apparatus. House refuse not removed by Authority.

15. Poole (Dorset); population (1891), 15,438; Dr. Bulstrode.

Sanitary Authority: Poole U.

Grounds of Inquiry: Complaints as to general unsanitary condition.

Chief Facts reported by Inspector: Water-supply apparently pure, but has a tendency to act on iron service pipes. No proper sewerage system for any part of district, but a scheme under consideration of authority for sewering by sections. Present means of excrement disposal by means of huge privy vaults, which are but rarely emptied, and which, in many instances in the parish of St. James', are in very dangerous positions. Privy accommodation very deficient. Isolation accommodation defective. No disinfecting apparatus. Bye-laws obsolete. Administration inefficient.

16. Risca (Monmouth); population (1891), 7,742; Dr. Fletcher.

Sanitary Authority: Risca U.

Grounds of Inquiry: Unsatisfactory reports of Medical Officer of Health and inactivity of the Sanitary Authority.

Chief Facts reported by Inspector: Want of sufficient house accommodation. No properly distributed water-supply. No systematic sewerage, and, as a consequence, considerable pollu-

tion of watercourses. Drainage of domestic premises almost non-existent. Excrement disposal unsatisfactory, and scavenging (not undertaken by the Sanitary Authority) inefficient. Compulsory notification not in force; Infectious Disease (Prevention) Act, 1890, and Public Health Acts Amendment Act, 1890, not adopted. No isolation hospital, and no efficient disinfecting apparatus. Byelaws with respect to cleansing of footways and pavements, removal of house refuse, cleansing of earth-closets, privies, ash-pits, and cesspools, &c., in force, but not observed, and not enforced by Sanitary Authority.

17. Rotherhithe, the Parish of St. Mary; population (1891), 39,255; Dr. Theodore Thomson.

Sanitary Authority: Rotherhithe Vestry.

Ground of Inquiry: Insufficiency of Sanitary Inspectors—complaint by London County Council.

Chief Facts reported by Inspector: Many dwellings defective in construction or in bad repair. Spaces around dwellings for the most part sufficient. A considerable proportion of yards badly paved or unpaved. House and yard drainage frequently defective. Watercloset basins often of bad patterns and not provided with proper flushing apparatus. Disposal and removal of house refuse fairly good. Nuisances abound throughout the district. Sanitary staff at date of inspection consisted of a Medical Officer of Health, one Sanitary Inspector, permanently appointed, two Assistant Sanitary Inspectors temporarily appointed, and a clerk. Byelaws and regulations made by the Vestry as regards nuisances, keeping of animals, paving of yards, cleanliness of receptacles for water storage, and waterclosets.

18. Ryedale (Yorks, N.R.); Dr. Bruce Low.

Sanitary Authorities: Helmsley R., Kirkbymoorside R., Malton U. and R.

Ground of Inquiry: Outbreak of enteric fever reported by Medical Officers of Health, and local complaints as to water-supply.

Chief Facts reported by Inspector: Nunnington; population (1891), 354; and Ness; population (1891), 95. Water-supply of both villages drawn from the River Rye, which is largely polluted by the sewage of Helmsley, and by the washings from land on which local privy "muck" and Leeds town manure are spread from time to time. Outbreak cut short by all water used for domestic purposes being boiled. New water-supply needed for both villages.

Butterwick; population (1891), 69; and Brawby; population (1891), 148. Outbreak attributed to use of drinking water taken from the River Rye, which is largely polluted by human excrement. These two villages (along with the two others which were also attacked by fever at the same time mentioned above) are situated on the banks of the Rye. The outbreak in the villages occurred within three weeks after a heavy flood. Such floods known in the locality to wash down accumulations of filth deposited on the river's banks, or in the beds of such tributaries as the Boro' Beck. New water-supply required for both villages.

Helmsley, population (1891), 1,508. — The crude sewage of Helmsley is discharged direct into the Rye or into its tributary, the Boro' Beck. Solid matters, containing excrement, are deposited in the channel of the Boro' Beck, and remain there till they are swept into the Rye by heavy rainfall. Helmsley is only six miles from Nunnington, the first of the villages involved in the fever outbreak.

Malton, population (1891), 4,910.—Public water supply drawn from a well close to banks of River Derwent, into which the Rye empties four miles higher up. In times of flood the Derwent rises rapidly and overflows its banks, occasionally reaching the town's well, the water in which then becomes thick and discoloured. Complaints at such times have been made by householders regarding the muddy character of the water supplied to them. Serious outbreaks of diarrhœa have been noticed to follow the use of this muddy water. Enteric fever has persisted in Malton for the last 20 years or more. The present public water supply of Malton is unsatisfactory owing to its liability to pollution.

19. Shildon and East Thickley (Durham); population (1891), 9,537; Dr. Bruce Low.

Sanitary Authority: Shildon and East Thickley U.

Ground of Inquiry: Enteric fever. Report by Medical Officer of Health.

Chief Facts reported by Inspector: Scattered imported cases of enteric fever during May, June, and July 1893 followed by considerable outburst of the disease in August and September, cases gradually diminishing in October and November. The earlier cases were mild, anomalous, and irregular, the later cases typical and severe. Many cases admittedly escaped notification and established foci of infection. Lower portion of district suffered severely; higher portion suffered considerably less in amount. Ventilation of sewers in lower parts very deficient; roadway grids purposely blocked up. No other openings provided. Complaints during summer of bad smells from yard gullies. Large, deep, uncovered midden privies in yards; upon these specific excreta were thrown undisinfected. Large share in diffusion of disease attributed to particular milk service. In the milk-seller's house there occurred three or four unnotified cases believed to have been enteric fever. The dairy where the milk was stored communicated directly with the sewer, without a bend or trap, by means of a 4-inch pipe in the sinkstone. History of flooding of milkman's cellar by sewage on two occasions in July after heavy rainfall.

Regulations under Dairies, Cowsheds, and Milkshops Order adopted by Sanitary Authority, but not enforced; no provision of hospital accommodation for infectious diseases; nor any proper means for thorough disinfecting of bedding, clothing, &c.

No evidence met with incriminating the public water supply of Shildon.

20. Tenbury (Worcester); population (1891), 1,325; Dr. Airy.

Sanitary Authority: Tenbury R.

Ground of Inquiry: Representation from County Council of Worcestershire as to polluted state of Tenbury water supply.

Chief Facts reported by Inspector: Town liable to be flooded from River Teme. Sewers liable to regurgitation in time of flood; discharge direct into River Teme. Water from wells, mostly shallow, sunk in porous gravel bed, polluted by leakage from cess-pits. Need of scavenging by Sanitary Authority.

Dr. Frankland's analysis of Tenbury water.—"Simply sewage "which has soaked through a few feet of porous soil."

21. Thorpe St. Andrew (Norfolk); population (1891), 1,317 (2,096 with inmates and officials of County Asylum); Dr. Copeman.

Sanitary Authority: Blofield R.

Ground of Inquiry: Sanitary condition of the village and of the "Old River." Representation by the Norfolk County Council.

Chief Facts reported by Inspector: Large proportion of houses of the cottage class. Overcrowding of dwellings; dampness of walls and foundations; want of proper surface drainage. Some houses built "back-to-back," or against rising ground.

Water supply from surface wells, and of bad quality. Cesspools not properly built or ventilated; overflows from some parts into river. No system of sewerage. Nuisance from large privy middens.

Various forms of infectious illness prevalent, but no hospital accommodation provided in district. Thorpe "Old River" silted up with accumulations of mud, derived in part from surface washings, and in part from sewage matter from Norwich, and overflows of cesspools, &c., from Thorpe.

22. Trent River; Dr. Bruce Low.

The Trent polluted almost at its source by sewage of pottery district of Staffordshire; lower down by the discharge into it of sewage, more or less untreated, from many large towns and populous districts in the counties of Stafford, Leicester, Derby, Notts, and Lincolnshire. The catchment area of the Trent further polluted by the spreading upon land of large quantities of privy midden refuse brought by rail or by river from towns such as Sheffield, Nottingham, and Lincoln. The river water directly contaminated by the excreta of persons on board barges and boats sailing on the Trent. Some populations use Trent water for drinking purposes on the lower and more polluted part of it.

Sanitary Authority: Gainsborough R., population (1891), 18,756.

Ground of Inquiry: Undue prevalence of enteric fever in riverside villages. Annual Report of the Medical Officer of Health.

Chief Facts reported by Inspector: Undue prevalence of enteric fever in eight Trentside villages whose main water supply is taken from the river a few miles below the town of Gainsborough, population (1891), 14,372, whose raw sewage is discharged direct into the Trent which is here a tidal river. Other villages not using Trent water almost entirely escaped attacks of fever during last few years.

Sanitary Authority: Newark U.; population (1891), 14,457.

Ground of Inquiry: Prevalence of enteric fever in the borough for some years. Annual Report of Medical Officer of Health.

Chief Facts reported by Inspector: Public water supply till recently consisted of water drawn from wells sunk in gravel adjoining the river. Supply inadequate, and of late years has been augmented by addition of water taken direct from the Trent and supplied to the town unfiltered. For some years enteric fever present in the town and often epidemic. Under advice of Medical Officer of Health a new supply obtained from New Red Sandstone; its use was commenced in July 1893.

Sanitary Authority: Thorne R.; population (1891), 11,802.

Ground of Inquiry: Unsatisfactory water supplies of whole district. Medical Officer of Health's annual reports.

Chief Facts reported by Inspector: Town of Thorne and some villages drink water from the canal which joins the Trent at Keadby, a few miles distant, two villages use Trent water, one village drinks water from the Dutch river, a tidal stream—all of which sources are polluted by human excrement, &c. Other villages have surface wells, or collect rainwater in cisterns; these sources are also liable to pollution from their proximity to privies, middens, pigsties, &c. Urgent need for new sources of water supply throughout the district.

23. Usk (Monmouth); population (1891), 1,417; Dr. Horne.

Sanitary Authority: Usk U.

Ground of Inquiry: Diphtheria. Registrar-General's Returns.

Chief Facts reported by Inspector: Water supply for the most part bad. Waterworks Company's water supplied to small minority of houses. Defective dwellings and some overcrowding of inmates. Absence of provision for flushing and ventilation of sewers. Unsatisfactory manner of dealing with sewage. Methods of excrement and refuse disposal defective.
Impossibility of ascertaining extent of diphtheria prevalence.
Infectious Disease (Notification) Act not in force.
Sporadic cases of diphtheria in neighbourhood for some time.
Inter-communication with infected contiguous district indicated as probable source of infection of Usk. "School influence" prominent as spreading and maintaining the disease. No disinfection of premises or clothing by Sanitary Authority. Absence of provision for isolation.

24. Uxbridge (Middlesex); population (1891), 14,439; Mr. E. Evans.

Sanitary Authority: Uxbridge R.

Ground of Inquiry: Local complaints concerning pollution of stream at Eastcote, and the want of drainage at Hayes.

Chief Facts reported by Inspector: Pollution of stream at Eastcote, and of the Frays River and the River Colne at Cowley, Yiewsley, and West Drayton. A large number of dwellings dilapidated, and many unfit for habitation. Sewers at Harefield and Colham Green unventilated, and want of proper system of sewerage throughout remainder of district. Water supply deficient in portions of Ickenham, Ruislip, and Northolt, and chiefly obtained from shallow wells and streams exposed to contamination at Cowley, Yiewsley, Hayes, and West Drayton. Gross nuisances from porous cesspits and

accumulations of refuse, the removal of which is not enforced by the Authority in accordance with their byelaws.

25. Whitby (Yorks, N.R.); population (1891), 13,106; Dr. Wilson.

Sanitary Authority: Whitby U.

Ground of Inquiry: General sanitary circumstances. Reports of Medical Officer of Health.

Chief Facts reported by Inspector: Many dwellings old and dilapidated. Sewerage modern. Sewers ventilated and flushed. Narrow yards on east side of old town have surface channel drainage. Most houses have pail closets, ashes put into the pails. Public water supply good but not constant. Contaminated wells still in use. Slaughter-houses and cowsheds insanitary. No isolation hospital except a wooden erection with two beds. Sewerage of Ruswarp defective. No systematic inspection by Medical Officer of Health. Reports meagre. Inspector of Nuisances has too much work.

26. Whitby Rural Sanitary District (Yorks, N.R.); population (1891), 9306; Dr. Maclean Wilson.

Sanitary Authority: Whitby R.

Ground of Inquiry: Arrangements for discharge of duties of Medical Officer of Health.

Chief Facts reported by Inspector: Defects in sanitation at the various villages; many of these not dealt with by Medical Officer of Health or Authority. Systematic inspection not made. Many houses unfit for habitation. New sewers required. Many houses without privies. Farm middens and village ponds are causes of nuisance. Water supply deficient in nearly every village. Byelaws and regulations required. Isolation hospital much needed.

27. Worthing, Borough of (Sussex); population (1891), 16,722; and the villages of Broadwater and West Tarring; Dr. Theodore Thomson.

Sanitary Authorities: Worthing Town Council, and East Preston R.

Ground of Inquiry: Epidemic of Enteric Fever.—Report of Medical Officer of Health.

Chief Facts reported by Inspector: In 1893 enteric fever cases to the number of 1,317 are known to have occurred in the Borough of Worthing, and 168 deaths were attributed to this disease. Of the 1,317 cases, 1,257 were in the part of the borough known as "Worthing," while 58 were in the remainder of the borough known as "West Worthing." Two neighbouring villages, viz., West Tarring and Broadwater (both in the East Preston Rural Sanitary District), also invaded by the fever, 55 cases and 9 deaths in the former and 41 cases and 9 deaths in the latter. In "Worthing" and Broadwater the epidemic occurred chiefly from May to mid-July, in "West Worthing" and West Tarring from mid-July to late August. Localisation of the fever in certain parts of "West Worthing" and West Tarring; but no localisation of the fever in "Worthing" and Broadwater. "Worthing" and Broadwater have a common water-supply; "West Worthing" and West

Tarring have a separate supply common to both. "West Worthing" has a separate sewerage system; "Worthing" and West Tarring have a sewerage system common to both; Broadwater has no system of sewerage. The epidemic was not referable to general sanitary circumstances, to sewerage or drainage, or to milk supply. The epidemic in "Worthing" and Broadwater was closely related in point of time to employment of a new source of water-supply; the disease was general throughout and limited to areas that received this water; in these areas incidence of the fever was almost wholly on houses supplied with this water, and this new source of supply was found to be open to dangerous contamination, shown by bacteriological examination to have occurred. The epidemic in "West Worthing" and West Tarring was probably referable to local infection of water mains.

28. Ystradyfodwg (Glamorgan); population (1891), 88,350; Dr. Bruce Low.

Sanitary Authority: Ystradyfodwg U.

Ground of Inquiry: Representations from Glamorganshire County Council under the Local Government (England and Wales) Act, 1888, to the effect that the Sanitary Authority had not properly enforced the Public Health Acts.

Chief Facts reported by Inspector: Administration until recently had been lax. Grave nuisances had been allowed to remain unabated. Serious fouling of the Rhondda rivers from excrement and other refuse deposited on the banks. Bye-laws in the past not properly enforced. Some prevalence of enteric fever in certain parts of district due in one case to a polluted water supply, in others to filth accumulations near dwellings. Hospital provision for infectious diseases inadequate. Of late, Sanitary Authority have shown commendable activity. In conjunction with the adjoining district of Pontypridd, they have provided a main sewer outfall to the sea, a distance of 17½ miles, at a cost of 156,000*l*. They are now constructing subsidiary sewers in the district to prevent fouling of the rivers, at a cost of 50,000*l*. They have appointed a new chief inspector who has five assistant inspectors under him, and these are making systematic house-to-house visits. All the objectionable vault privies are being transformed into w.cs. Since the inspection, the Sanitary Authority have adopted the Infectious Disease (Notification) Act, 1889, the Infectious Disease (Prevention) Act, 1890, and the Public Health Acts Amendment Act, 1890. The byelaws are now being enforced. The district which is peculiarly situated in two deep narrow valleys, and populated almost entirely by colliers, presents considerable difficulties in dealing with refuse, &c. General improvement is now taking place, and the Sanitary Authority are displaying more activity in their administration, under the advice of their Medical Officer of Health and chief inspector.

No. 6.

Report on an Epidemic of Enteric Fever in the Borough of Worthing and in the Villages of Broadwater and West Tarring; by Dr. Theodore Thomson.

On May 23rd, 1893, the Board was informed by the Medical Officer of Health of the borough of Worthing that an outbreak of enteric fever was in progress there, and that measures were being taken by the Sanitary Authority to deal with the disease. This information was followed by a more detailed report from the Medical Officer of Health, received by the Board on June 2nd. In this report the epidemic was stated to be abating, and some particulars were given as to the measures that had been adopted by the Sanitary Authority, and as to the probable cause of the outbreak. In a further report, dated June 17th, the Medical Officer of Health gave statistical account of the fever, and stated that the epidemic was over. Early in July, however, the Board received from the Sanitary Authority, and from medical men and others resident in the place, representations setting forth that a further and more formidable outbreak of enteric fever was in progress, and urging the Board to make inquiry into the cause of this outbreak. I was accordingly instructed by the Board to make inquiry into the circumstances in which enteric fever had been prevailing in Worthing, and to this end I visited Worthing, on July 12th and on several subsequent occasions. The facts which, as the result of my investigations, came to my knowledge I now proceed to set forth.

During 1893 only two cases of enteric fever had, prior to the month of May, been notified to the Worthing Urban Sanitary Authority as having occurred in their district. One of these cases occurred in January the other in February. On May 3rd an additional case of enteric fever was notified to the Urban Sanitary Authority, to be followed five days later by the notification of a plurality of cases. Thenceforward the disease increased so rapidly that by June 9th notification of 284 cases had been received. From June 10th to July 1st there would appear to have been a lull in the extension of the disease, for the notifications received during these three weeks amounted to the relatively small number of 19 only. But, on July 2nd, the number of persons attacked began again to increase and this so markedly that in the course of July alone no less than 678 fever cases were notified to the Urban Sanitary Authority as occurring in their district. Subsequent to July the epidemic continued to prevail, although with gradual abatement, through August, September, and October, but had, by the end of November, so far diminished that during that month no more than nine cases of the disease were notified to the Urban Sanitary Authority. In all, during the period from May 3rd to the end of November, 1,315 attacks are known to have occurred in the borough of Worthing, with 168 deaths.

In addition to the town of Worthing, two neighbouring villages, Broadwater and West Tarring, participated in this epidemic. During the already-mentioned period of May 3rd to the end of November, 55 cases of enteric fever are known to have occurred in West Tarring and 41 in Broadwater, nine proving fatal in each of these places. The total number, therefore, of persons known to have been attacked by enteric fever during this period in Worthing, Broadwater, and West Tarring amounts to 1,411.

These three places, Worthing Borough, Broadwater, and West Tarring, lie near together at the foot of the Sussex Downs. Worthing abuts on the sea, while the villages of Broadwater and West Tarring lie inland in a northerly direction from Worthing. Broadwater village lies rather less than a mile to the east of the village of West Tarring and both are practically continuous with Worthing. All three are on the

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Chalk, which for the most part lies very near the surface. Across part of Broadwater runs a narrow alluvial strip; and this is the case in Worthing also, where, moreover, the Reading and Woolwich Beds are sparingly represented.

The borough of Worthing is 1,405 acres in extent, and at the census of 1891 contained 3,044 inhabited houses, with a population of 16,606 persons. The villages of Broadwater and West Tarring are both in the East Preston Rural Sanitary District, and contain the greater part of the population of the parishes of the same names. In view of the limitation of the epidemic to the village portions of these parishes I had a census made of these villages during the summer of 1893; and in this way ascertained that Broadwater village then contained 191 inhabited houses with a population of 787, and West Tarring 229 inhabited houses and 1,070 persons. The following tables (Tables I. and II.) show, from May to November inclusive, the incidence of enteric fever, as regards both sickness and mortality, on each of the areas invaded.

In these Tables, and throughout the rest of this report, the borough of Worthing is for reasons which will presently appear, regarded as consisting of two parts, termed respectively "Worthing" and "West Worthing." Reference to the Urban Sanitary District of Worthing, which comprises "Worthing" and "West Worthing," will herein-after be made only under the title "Borough of Worthing."

Table I.

Showing severally for "Worthing," "West Worthing," West Tarring, and Broadwater, the Population, the Number of Enteric Fever Cases ascertained to have occurred in the Seven Months May to November 1893, and the Rates of Attacks per 1,000 of the Population.

Sanitary District.	Area invaded by Enteric Fever.	Estimated Population in middle of 1893.	No. of Cases of Enteric Fever.	Attack-rate per 1,000 Population.
Borough of Worthing	"Worthing" -	15,317	1,257	82·0
	"West Worthing" -	2,116	58	27·4
East Preston Rural Sanitary District -	Village of West Tarring - -	1,070	55	51·4
	Village of Broadwater	787	41	53·4

Table II.

Showing severally for "Worthing," "West Worthing," West Tarring, and Broadwater, the Population, the Number of Deaths referred to Enteric Fever in the Seven Months May to November 1893, and the Resulting Death-rates per 1,000 Inhabitants.

Sanitary District.	Area invaded by Enteric Fever.	Estimated Population in the middle of 1893.	Enteric Fever. No. of Deaths.	Enteric Fever. Death-rate per 1,000 Inhabitants.
Borough of Worthing	"Worthing" -	15,317	153	10·0
	"West Worthing" -	2,116	15	7·1
East Preston Rural Sanitary District -	Village of West Tarring - -	1,070	9	8·4
	Village of Broadwater	787	9	11·4

From Table I. it appears that, taking the epidemic as a whole, the chief incidence of *attack* was on "Worthing"; that Broadwater and West Tarring were in this respect affected almost equally, but to a less degree than "Worthing"; and that the smallest incidence of attack was on "West Worthing." From Table II. it will be seen that relatively to population there were more *deaths* in Broadwater than in any of the other three districts; and that next in order comes "Worthing," followed by West Tarring and by "West Worthing,"—the area last-named suffering least from deaths as from attacks. Table I., however, gives a more trustworthy indication of the relative prevalence of enteric fever in these four areas than does Table II., inasmuch as (save in the case of "Worthing"), the death figures being small, deductions therefrom are to a corresponding extent unsafe. No doubt the attack figures in certain of the areas are also small and to some extent the same objection applies to deductions based on them; they are, however, four or five times as large as the deaths, and therefore the more trustworthy.

These four places differ one from the other in several respects. Of the town area, the "Worthing" section contains in very large proportion persons earning their livelihood in one or other of the occupations common to seaside resorts, or employed in connexion with fruit growing, which is a considerable industry in the district. "West Worthing," on the other hand, while containing a small proportion of the class that mainly composes the "Worthing" population, is largely a good class residential neighbourhood. The inhabitants of the villages of West Tarring and Broadwater are for the most part in poor circumstances, and are dependent on fruit growing and on agricultural pursuits. The inter-relations of the four places as regards sewerage and water supply are somewhat complicated. Thus "West Worthing," and about three-fourths of the village of West Tarring, have a common water supply from the public service of "West Worthing"; "Worthing" and about one-third of the village of Broadwater have a common water supply from the public service of "Worthing"; the parts of West Tarring and Broadwater not thus accounted for are supplied from local wells. Again, "West Worthing" has a system of sewers entirely confined to that district; "Worthing" and almost the whole of the village of West Tarring drain into the "Worthing" sewers; while Broadwater village drains entirely into cesspools and ditches. For the sake of clearness I append a table in which these facts are set forth.

TABLE III.

SHOWING in regard of WATER SUPPLY and DRAINAGE ARRANGEMENTS the Inter-relations and the Divergences of "WORTHING," "WEST WORTHING," WEST TARRING, and BROADWATER.

Sanitary District.	Area invaded by Enteric Fever.	Water Supply.	Drainage.
Borough of Worthing -	"Worthing"	"WORTHING" WATERWORKS.	"WORTHING" SEWERAGE SYSTEM.
	"West Worthing."	"West Worthing" Waterworks.	"West Worthing" Sewerage System.
East Preston Rural Sanitary District -	Village of West Tarring.	¾ "West Worthing" Waterworks. ¼ *local wells.*	Almost entirely on the "WORTHING" SEWERAGE SYSTEM; the remainder drains into *cesspools.*
	Village of Broadwater.	⅓ "WORTHING" WATERWORKS. ⅔ *local wells.*	Drains into *cesspools and ditches.*

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On Enteric Fever in Worthing, Broadwater and West Tarring, by Dr. Theodore Thomson.

Enteric Fever in and about Worthing in previous Years.

The history of the above areas as regards enteric fever mortality during the past 11 years will be gathered from the annexed table (Table IV.), where I have dealt with "Worthing" and "West Worthing" together, under the title "Borough of Worthing." I make no attempt to supply death-rates per 1,000 living for any local area except the borough; the small size of the villages of West Tarring and Broadwater rendering, as I have said, calculations based on the few figures for these areas of very doubtful value.

Table IV.

Showing year by year for the 11 years 1883–1893, the Deaths from Enteric Fever in the Borough of Worthing, and in West Tarring and Broadwater Villages; and affording comparison of Death-rates from this disease in the Borough and in England and Wales.

Year.	Borough of Worthing (comprising "Worthing" and "West Worthing").			No of Deaths from Enteric Fever in the		England and Wales.
	Population.	No. of Deaths from Enteric Fever.	Enteric Fever. Death-rate per 1,000 living.	Village of Broadwater.	Village of West Tarring.	Enteric Fever Death-rate per 1,000 living
1883	12,180	2	0·16	—	—	0·23
1884	12,650	2	0·16	—	—	0·24
1885	13,040	3	0·23	—	—	0·17
1886	13,200	1	0·08	—	—	0·18
1887	13,350	1	0·08	—	—	0·16
1888	13,800	—	0.00	—	—	0·17
1889	14,200	2	0·14	—	—	0·18
1890	14,650	2	0·14	—	—	0·18
1891	16,722*	—	0·00	—	1	0·17
1892	17,220	3	0·17	—	2	0·15†
1893 (May to Nov.)	17,433	168	2·64	9	9	0·16‡

It will be seen, on comparison of the figures in Table IV. for the Borough of Worthing with those for England and Wales that, antecedent to 1893, this borough suffered less from enteric fever mortality than the country at large. Rarely did its death-rate from enteric fever equal the corresponding rate for England and Wales. So, too, with the villages of Tarring and Broadwater; in them no death was attributed to enteric fever during the first eight of the 11 years tabulated. In 1891 one death and in 1892 two deaths were referred to this cause in West Tarring village; but during these two years, as in the preceding eight, Broadwater remained entirely free from fatal enteric fever.

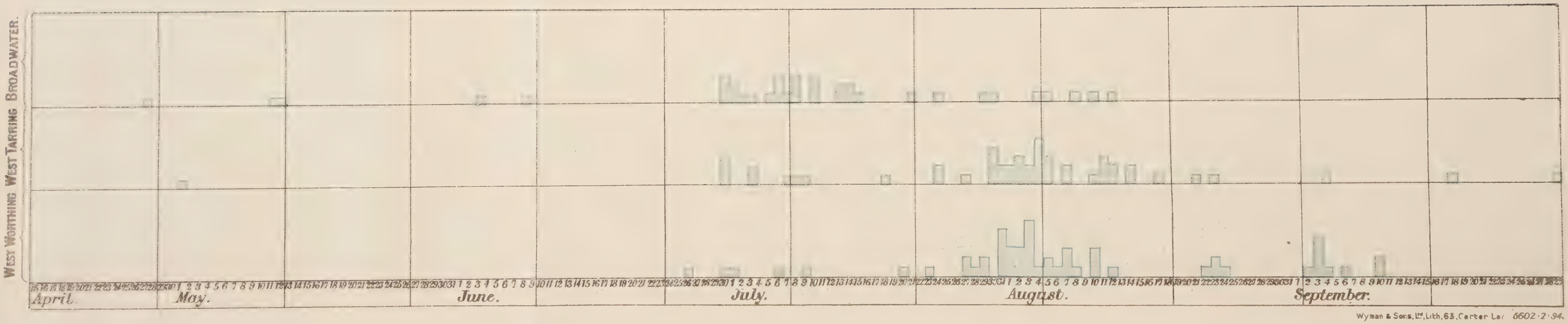
* In September 1890, the limits of the borough were extended, and the additional population thus included accounts in part for the considerably increased population of 1891.

† The 1892 figures in this column are those given in the Registrar-General's quarterly returns as to "Fever;" they represent the death-rate from enteric, typhus, and simple or ill-defined forms of continued fever.

‡ "Fever" death-rate per 1,000 living in England and Wales during the second, third, and fourth quarters of 1893.

CHART IV.

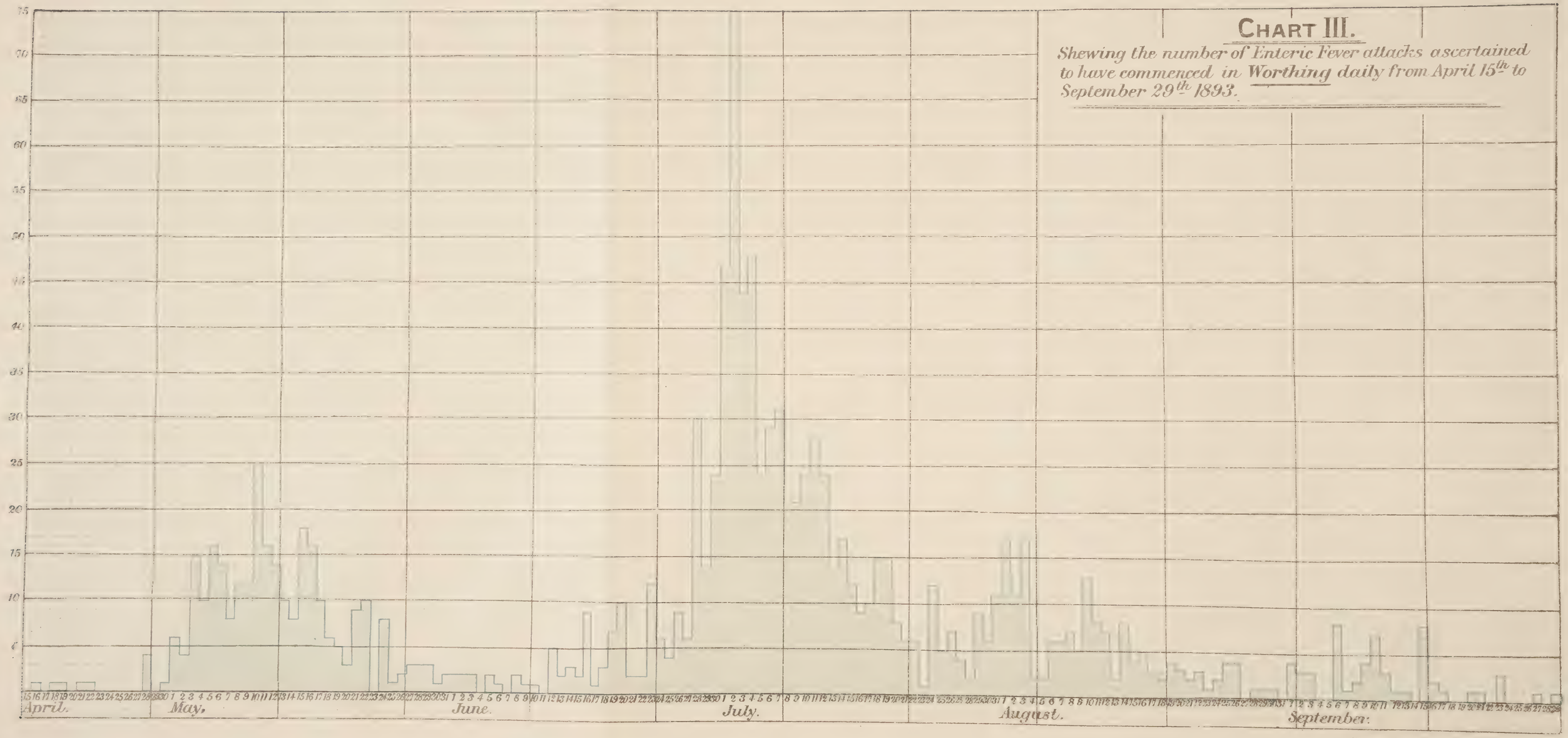
Shewing the number of Enteric Fever attacks ascertained to have commenced in West Worthing, West Tarring, and Broadwater; daily from April 15th to September 29th 1893.



Wyman & Sons, Lt.d, Lith, 63, Carter Lane 6602·2·94.

Chart III.

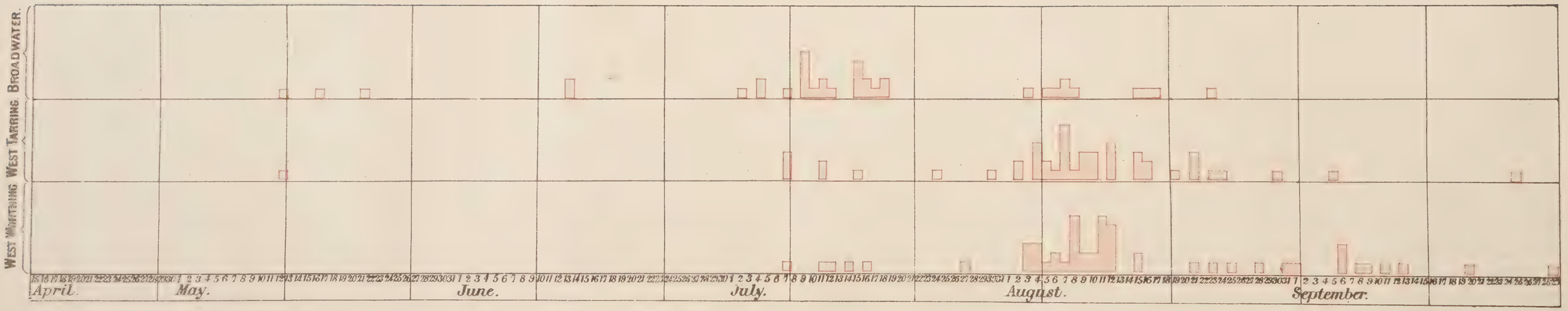
Shewing the number of Enteric Fever attacks ascertained to have commenced in Worthing daily from April 15th to September 29th 1893.



Wyman & Sons, Ltd. Lith. 63, Carter Lane 5602·2·94.

CHART II.

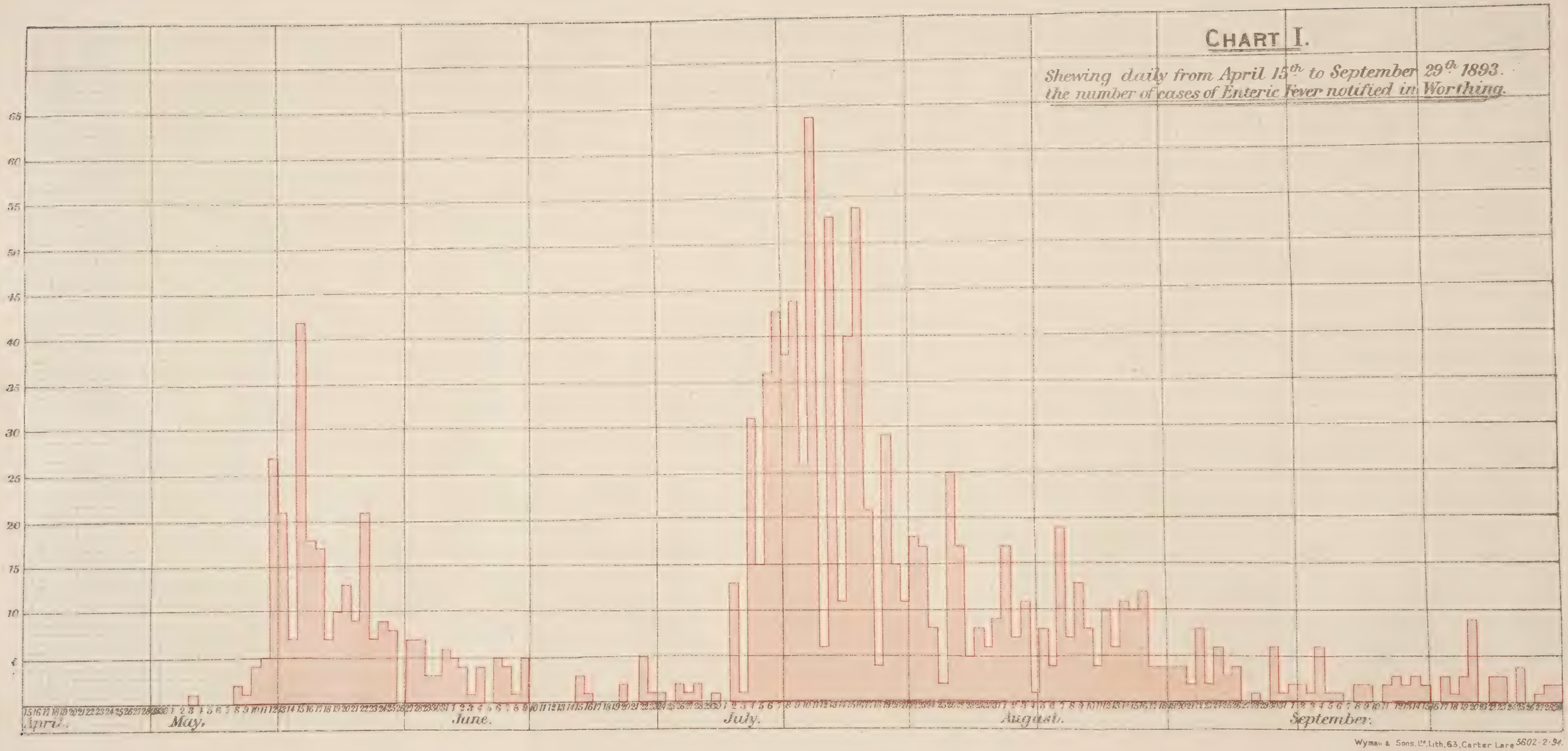
Shewing daily from April 15th to September 29th 1893, the number of cases of Enteric Fever notified to West Worthing, West Tarring, and Broadwater.



Wyman & Sons, Ltd, Lith, 63, Carter Lane 5602·2·94.

CHART I.

Shewing daily from April 15th to September 29th 1893. the number of cases of Enteric Fever notified in Worthing.



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To what, then, is to be attributed the epidemic of enteric fever, that so suddenly, and with results so serious, invaded all these places in 1893?

With the view of finding a reply to this question it will be necessary to study in some detail the rise and progress of the outbreak; to note any differences that may be discernible as to distribution in time and in space of the fever in the several areas under examination; and to consider, for each area and for the four areas collectively, one and another condition reputedly causative of enteric fever, in its possible relation to the behaviour of the disease as witnessed in this epidemic.

Rise and Progress of the Outbreak.

The commencement and the subsequent course of the outbreak are exhibited in detail in the subjoined tables, Tables V. and VI., as also in the charts (I.–IV.) opposite, and the maps (3–15) attached to this report.

Table V.

Showing fortnightly, from March to December 1893, the number of cases of Enteric Fever *notified* in "Worthing," "West Worthing," West Tarring, and Broadwater.

Period.	"Worthing" (population, 15,317).	"West Worthing" (population, 2,116).	Village of West Tarring (population, 1,070).	Village of Broadwater (population, 787).
Month of January	1	—	—	—
„ February	1	—	—	—
„ March	—	—	—	—
April 1—14	—	—	—	—
„ 15—28	—	—	—	—
„ 29—May 12	40	—	1	1
May 13—26	189	—	—	2
„ 27—June 9	55	—	—	—
June 10—23	12	—	—	2
„ 24—July 7	146	1	3	4
July 8—21	418	4	3	18
„ 22—Aug. 4	151	7	8	1
Aug. 5—18	120	27	25	3
„ 19—Sept. 1	43	6	7	1
Sept. 2—15	27	7	1	—
„ 16—29	31	2	1	—
„ 30—Oct. 13	8	1	3	1
Oct. 14—27	9	—	1	—
„ 28—Nov. 10	6	—	1	—
Nov. 11—24	2	3	1	3
„ 25—Dec. 8	—	—	—	—
Total	1,259	58	55	41

Table V. shows fortnight by fortnight the number of cases notified from March to December 1893, in each of the four invaded areas, in all of which compulsory notification of enteric fever (among other diseases) is in force. In the charts corresponding to this table (Charts I. and II.), the notifications received are shown day by day for a somewhat

Arr. A No. 6. shorter period than that covered by the table. Table VI. and the charts corresponding to it (Charts III. and IV.) are based upon the *actual dates* on which persons attacked are stated to have first shown symptoms of illness, and are therefore to be preferred in comparisons as to time-incidence of the disease on one and another area.

TABLE VI.

SHOWING the Number of ENTERIC FEVER Attacks *ascertained to have commenced* in each fortnight from March to December 1893, in "WORTHING," "WEST WORTHING," WEST TARRING, and BROADWATER.

Period	"Worthing" (population, 15,817).	"West Worthing" (population, 2,116).	Village of West Tarring (population, 1,674).	Village of Broadwater (population, 787).
The month of January -	1	—	—	—
,, February -	1	—	—	—
,, March -	—	—	—	—
April 1—14 - -	—	—	—	—
,, 15—28 - -	9	—	—	1
,, 29—May 12 -	153	—	1	2
May 13—26 - -	106	—	—	—
,, 27—June 9 -	24	—	—	2
June 10—23 - -	59	—	—	—
,, 24—July 7 -	391	4	6	12
July 8—21 - -	225	2	3	12
,, 22—Aug. 4 -	110	24	21	4
Aug. 5—18 - -	78	11	14	4
,, 19—Sept. 1 -	30	4	2	—
Sept. 2—15 - -	41	2	1	—
,, 16—29 - -	10	—	2	—
,, 30—Oct. 13 -	6	1	5	1
Oct. 14—27 - -	9	—	—	2
,, 28—Nov. 10 -	5	2	—	1
Nov. 11—24 - -	1	1	—	—
,, 25—Dec. 8 -	—	—	—	—
Total - -	1,259	58	55	41

Study of these data reveals the fact that the behaviour of the disease, in the matter of time distribution, was not the same in all four invaded areas.

Incidence in regard of Time.—In "Worthing" the first case of the epidemic would appear (*see* Chart III.) to have occurred in the second fortnight of April; and in this area, after a sharp outburst occupying mainly the first three weeks of May, the epidemic abated considerably. This decadence of the fever did not, however, long continue. About the middle of June, there occurred fresh increase in the number of attacks, which culminated about the end of the month and the early part of July in an outburst of remarkable intensity. During the remainder of July and through August and September the fever in "Worthing" was maintained with occasional exacerbations but with gradual abatement. By October it had so far diminished that in that month but 18 persons are known to have been attacked. By December the epidemic may be considered to have been over, as three attacks only are known to have occurred in the previous month.

In the village of Broadwater one case of enteric fever is known to have commenced in the latter part of April, while two are recorded in

the month of May, and two more in the beginning of June. Having regard to the comparatively few inhabitants of the village, the incidence of the enteric fever thus corresponds in time with the behaviour of the disease in "Worthing," although Broadwater suffered less than "Worthing" relatively to its population. But in Broadwater as in "Worthing," there was a marked recrudescence of the disease at the end of June and in the beginning of July; at this time, indeed, Broadwater suffered rather more than "Worthing" in proportion to its population. After the middle of August the disease would seem to have been in abeyance in Broadwater until October, when three cases are known to have occurred, and one more person was attacked in November. It will, therefore, be seen that, making allowance for the element of uncertainty always attaching to figures dealing with small populations, the rise and subsequent course of the disease in Broadwater was parallel with that in "Worthing."

But in "West Worthing" and in West Tarring the commencement and the progress of the enteric fever outbreak that occurred in these places were in some respects totally unlike what took place in "Worthing" and Broadwater.

In West Tarring, with the single exception of one case in the early part of May, no person is known to have been attacked by enteric fever until June 30th; moreover, the chief outbreak of the fever in this place did not occur until the end of July or the beginning of August; that is to say, not until a month later than the time at which the incidence was greatest on "Worthing" and Broadwater. After the month of August occasional cases are known to have occurred in West Tarring up to November 14th, since when the disease does not appear to have manifested itself in the village.

In "West Worthing" no person is known to have been attacked by enteric fever prior to June 26th. In this district, as in West Tarring, the chief prevalence of the fever did not, as in "Worthing" and Broadwater, occur in May and again in early and middle July, but at the end of July and in the beginning of August. Here too, again, as in the case of West Tarring, the disease would seem to have made only occasional appearances after the month of August.

From the foregoing account it appears that, as regards the date at which the disease became epidemic, and, as regards also that at which it reached its maximum, "Worthing" resembled Broadwater, whereas "West Worthing" resembled West Tarring; and, further, that "West Worthing" and West Tarring differed conspicuously from "Worthing" and Broadwater in this sense.

Distribution over Area.—Differences appear also as regards the extent to which the total area of each of the four invaded localities was implicated by the fever epidemic. These differences are illustrated by the maps, to which I have already made reference, and which are attached to this report. The maps in question cover the period April 15th to October 13th, and on them the cases of enteric fever, as they occurred fortnight by fortnight, are represented by red dots. The fortnightly periods thus illustrated correspond with the fortnightly periods in Tables V. and VI. From these maps it will be seen that the fever was generally and well nigh impartially distributed throughout "Worthing." Certain parts of this area, it is true, show now and then a thicker clustering of spots than is elsewhere noticeable; but these are the localities in "Worthing" which are most densely inhabited, and where, accordingly, with an equally diffused cause of fever, a closer aggregation of cases would be anticipated. In Broadwater, also, the

distribution of the disease is observed to be general over the whole village. In "West Worthing," on the other hand, this indifference of distribution of the fever is not found. There was a large preponderance of cases (47 out of a total 58) in a block of streets occupying the south-east corner of "West Worthing." It is true that this is the part of "West Worthing" which is most densely inhabited, containing as it does 970 out of the total 2,116 persons in the place; but with due allowance made for this fact, the proportion of cases occurring hereabouts shows a very special incidence on this section of "West Worthing." A similar special localisation of the fever is to be seen in the distribution of cases in the village of West Tarring, where a group of streets near the southern limit of the place were affected in much greater degree than the remainder of the village. The group of streets referred to contains less than two-thirds of the population of West Tarring village; and yet 51, out of the total number of 55 known cases of enteric fever, occurred in this particular locality.

Thus, as regards distribution over area as with distribution in time, the behaviour of the epidemic in "Worthing" resembled the behaviour of the epidemic in Broadwater; while the "West Worthing" outbreak resembled, in both senses, that in West Tarring. There can be no question that the latter two places were invaded in different fashion from the two former. The disease was co-incident in time in, and general in its distribution throughout, both "Worthing" and Broadwater, whereas in "West Worthing" and in West Tarring the epidemic was later in appearing, and the fever when it came was to a great extent limited to a particular section of each of these areas. These discrepancies might, it was seen, be thought to suggest that the prevalence of enteric fever in the four invaded places had been due to diverse fever agencies; and, accordingly, in searching for the factor or factors responsible for the occurrence of the disease due regard was had to this aspect of the question.

Cause of the Outbreak.

In searching for the factors concerned in the epidemic prevalence of enteric fever in these four localities, the general sanitary circumstances, the sewerage and drainage, the milk and the water supplies were in turn investigated. Each of these possible agencies of fever distribution I shall now pass in review.

General Sanitary Circumstances.

In "*Worthing*" *with* "*West Worthing*"* the streets are for the most part well constructed and are kept clean; the houses of the poorer classes are in fair condition; but in not a few instances open space around poor class dwellings is somewhat scanty. Excreta are removed by water carriage; the prevailing form of closet basin being the long hopper, not always, however, provided with a separate flushing cistern. Disposal and removal of house refuse leave a good deal to be desired. The lower parts of the town are liable to occasional flooding from backing up of sewer contents by the tide. A considerable nuisance is not infrequently caused by the odour arising from decaying accumulations of seaweed on the foreshore. These accumulations are sometimes very large, especially after a south-westerly gale.

* It will be remembered than these places are under the jurisdiction of one and the same sanitary authority, the Town Council of Worthing.

In *West Tarring** the roadways are on the whole fairly constructed and kept; the houses of the poorer class are in some instances in fairly good condition, while in others they are old, indifferently lighted and ventilated, and occasionally damp and dilapidated. Disposal of excreta is partly by waterclosets, chiefly of the long hopper pattern, partly by cesspit privies. Disposal of refuse is capable of much improvement: removal of refuse by the Sanitary Authority is somewhat irregular, and it is not universal, as the material is often made use of by occupiers on their gardens.

In *Broadwater** a considerable proportion of the houses are old, and some are badly lighted and ventilated; some are also damp. Roadways are in moderate condition of repair and cleanliness. Excreta are disposed of in privy cesspits or privy middens, intermittently scavenged, or by waterclosets, chiefly of the long hopper pattern and usually hand flushed. House refuse is for the most part made use of for garden purposes.

The general sanitary condition of these four places is, as the foregoing account shows, in several respects unsatisfactory. Nevertheless their defects are by no means such as to invite an outbreak of enteric fever of the severity and the dimensions that have been described. And as a matter of fact, exceptional incidence of the disease was not, in any of the four areas, noticed in those sections of them presenting most conspicuously defective hygienic conditions; indeed, large numbers of individual houses were invaded, to the sanitary arrangements and surrounding of which little or no exception could be taken.

Sewerage and Drainage Arrangements.†

"*Worthing.*"—The main sewers in "Worthing" are built in some instances of brickwork, others are constructed of stoneware pipes. They are not all well made or in good condition. The following is an extract from a statement supplied to me by the Borough Surveyor regarding old sewers:—"I am informed that until a few years back, "cement was not used for the pipe joints, so it may be taken that the joints "of the bulk of the old pipe sewers were made of clay. Prior to my ap- "pointment in 1891, I am informed it was usual to allow the pipe sewers "to be cut into for house connections instead of using proper junctions; "occasional excavations made bear out these statements: excavations made "to the brick sewers show they are not watertight and that silt accumulates "where the gradients are not self-cleansing." As regards the gradients of the "Worthing" sewers the Borough Surveyor states as follows:— "The general fall of sewers running north and south is good with a few "exceptions; the main sewer from the south end of Upper High "Street to the junction in the park is nearly dead level, with a very "slight fall the wrong way, and the Montague Street sewer from "Gratwicke Road to Surrey Street is in the same state; a few of the "sewers running east and west are not self-cleansing." Ventilation of sewers is mainly secured by street gratings, and is in some instances satisfactory, in others insufficient.

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* Under the jurisdiction of the East Preston Rural Sanitary Authority.

† Comprehension of the sewerage arrangements of the four areas under discussion will be facilitated by reference to the sewerage map (Map 2) attached to this report. On this map the sewers of "Worthing" and West Tarring, which have their sewerage system in common, are shown by red lines: while the "West Worthing" sewers are shown by blue lines.

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On Enteric Fever at Worthing, Bournemouth and West Tarring, by Dr. Theodore Thomson.

Prior to April 1893, when the amount of the "Worthing" water supply was increased, the sewers were flushed by occasional release of a considerable volume of their contents, previously penned up at certain points by means of movable discs until a sufficient head of sewage had been gained. The surveyor states that after the increase of water supply in April 1893, "the sewers were well flushed by hose pipes at "the manholes prior to the epidemic, and extra flushing was done "during the epidemic both to sewers and house drains, the extra water "pumped for this purpose daily often being at the rate of 25 gallons "per head over the normal supply of 30 gallons per head." Owing to the low level of "Worthing"—of which the highest point on the ground surface is but 36 feet above Ordnance datum, while in places it is only 9 feet above datum—the sewers are tide-locked during large part of the 24 hours. The "Worthing" outfall sewer is a 4-foot barrel which discharges, about one and a half mile east of Worthing pier, into a 30-inch iron pipe by which the sewage is carried out to sea. Some experiments conducted by the Borough Surveyor showed that "in dry "weather the backing up of the sewers at entrance to waterworks yard "during tidelock ranged from 2 ft. to 3ft. 1 in. above invert, with a water "supply of 30 gallons per head; in wet weather the backing up "extended to the bottom of South Street, and, during storms, along "Montague Street and up branch sewers." The amount of backing up thus set forth will be better appreciated when I state that the invert of the sewer at the entrance to the waterworks yard (shown as an irregular blue patch near to Park Road, Worthing, in Map 1) is at Ordnance datum level.

House drains are in few instances properly ventilated and disconnected from the sewers. Disconnexion of house drains from interiors of houses is usual as regards sink and bath wastes; but soil pipes are not infrequently ventilated by shafts of too small diameter, and are in some instances devoid of ventilation. The majority of waterclosets, however, are situated out of doors.

"*West Worthing*."—The description just given of the "Worthing" sewerage and drainage arrangements applies equally to the "West Worthing" sewerage and drainage, although the "West Worthing" sewers constitute an absolutely separate system. They are at no point connected with the sewers of Worthing or of any other district, and they discharge by a separate outfall into the sea, about a mile to the west of Worthing pier. In "West Worthing" also the sewers back-up during tide-lock; main sewers have not always a proper fall, and old sewers are in the condition already described. As regards house drainage, the unsatisfactory features referred to as existing in connexion with "Worthing" are equally common in "West Worthing."

West Tarring.—The main sewerage arrangements in West Tarring village resemble the more recently and better constructed sewers of "Worthing," of the sewerage system of which the West Tarring sewers constitute a part. The whole of the West Tarring sewage, save that from 14 houses—which either drain into cesspools or have no drainage arrangements—passes into the village sewers, thence into the "Worthing" sewer, and so into the sea through the Worthing discharge pipe. House drainage in West Tarring resembles that of "Worthing" and "West Worthing."

Broadwater.—In Broadwater there is no system of sewerage. For the most part houses drain into cesspools, which are cleansed at irregular intervals. Disconnexion of sink wastes is usual, and indoor waterclosets are rare. House drains are unventilated.

So far, then, as sewerage arrangements are concerned, it is clear that the main outbreak, which followed a parallel course in "Worthing" and Broadwater, cannot be attributed to sewer emanations, inasmuch as Broadwater has no drainage relations with "Worthing," and is indeed devoid of sewers. Nor was there, assuming sewer emanations as a cause of fever in "Worthing" itself, exceptional incidence of the disease on the inhabitants of houses in those streets known to be badly sewered. The two localised, though separate, outbreaks in "West Worthing" and in West Tarring, respectively, present perhaps behaviour more compatible with sewer infection; but even in these instances there must be hesitancy in attributing the disease to this cause. For the "West Worthing" and the West Tarring sewers are on separate systems, and the sewers of the invaded localities in those areas were in better condition than those in other streets that escaped or were but lightly touched by the epidemic; and, in addition, almost all the invaded houses in these two places were properly secured against entrance of sewer air into their interiors.

In short, the behaviour of the disease generally is opposed to any probability of sewer infection as a cause. Its behaviour in "Worthing" was similar to its behaviour in Broadwater village, and yet the "Worthing" sewers do not extend into Broadwater village, which is, as has been said, wholly without sewers. In "Worthing" and West Tarring, again, there were striking differences in the manner of rise and progress of the fever, notwithstanding that these two places have a common sewerage system. In "West Worthing," moreover, which has its own separate sewerage system, the disease behaved quite otherwise than in "Worthing," and instead closely followed the course taken by it in West Tarring, which is, as already stated, on the same sewerage system as "Worthing."

In view of these facts, it becomes apparent that a sufficient explanation of the cause of the outbreak of enteric fever in these four places is not to be found in infection propagated by emanations from sewers.

Milk Supply.

In the rapidity with which they obtained their maxima in the four places invaded, the enteric fever outbreaks displayed a feature usually to be found in epidemics of which the causation lies in milk. On the other hand, the persistence of these outbreaks, and their slow subsidence, did not harmonize with this method of causation of the fever, nor was there that especial incidence of the disease on women and children* so characteristic of milk epidemics. It did not seem probable, moreover, seeing that all four places receive their milk in large part from the same vendors, that two of these places should have been attacked in April and May, and again in June and July, while the other two should have almost entirely escaped until July–August. Nevertheless, careful inquiry was made into the possible operation of milk supply in causing any of the outbreaks in the four localities. In "Worthing" the source of milk supply was ascertained in the case of 1,231 out of the 1,257 persons attacked. The milk supply of these 1,231 persons came from one or other of all the milk vendors in "Worthing," who are 15 in number. Similarly the milk supplied to those persons who had contracted enteric fever in Broadwater, came from six different vendors; in "West Worthing" from eight; and in West Tarring from four

* The incidence of the fever on sex and age was closely studied in view of this and of other considerations.

App. A. No. 6. [illegible] and West Tarring. By Dr. Theodore Thomson.

sources. Attempt was also made to ascertain what proportion of the total customers of each separate vendor had been attacked; but the difficulties experienced in trying to obtain the number of customers in each instance were found to be so great as to forbid more than an approximate estimate on the subject. Sufficient was learned, however, to show that the proportion of cases to customers was in no instance so exceptional as to point to milk having acted as the medium of propagation of enteric fever in any of the outbreaks in the four places invaded.

Water Supply.

In the absence of evidence implicating, as cause of the epidemic, any one of the possible agencies thus far discussed, water supply—which has so often been found elsewhere to have served as the medium of sudden and widespread propagation of enteric fever—naturally came under suspicion.

The four areas affected by the fever are supplied, as stated at an earlier stage of this report, with water from three sources, viz., the "Worthing" public service, the "West Worthing" public service, and local wells. A proper comprehension of the part that water may have played in bringing about the epidemic cannot be arrived at without a detailed account of the circumstances of these water supplies, and the different conditions of distribution of public water service in one and another of the several areas.

The "Worthing" Public Service.—The "Worthing" Waterworks are the property of the Worthing Corporation, and are situated within the borough. They are depicted as an irregular blue area on the annexed map (Map 1) showing the distribution of the water mains. The site is an enclosed plot of ground of about two acres in extent. The Chalk here lies at a depth of about 18 to 20 feet from the surface, the intervening soil consisting from above downwards of loamy mould, marl, and chalky marl. The supply is from certain deep wells and from headings therefrom driven into the Chalk, the water being pumped up by an engine on the site. This water is not filtered. The greater part of this supply is delivered directly into a rising main, by which it is distributed to "Worthing" and to Broadwater, but not to "West Worthing" or to West Tarring; the surplus passes into a tank situated at the top of a brick tower 90 feet in height. When this tank is full the engine ceases pumping, and the tank water is distributed by gravitation until the tank is about three parts emptied; whereupon this supply is stopped, and the engines again pump from the wells directly into the mains and tank. The supply, therefore, is constant. Tank-water is usually distributed by the "Worthing" mains from 6 a.m. to 6.30 a.m., and again from 12 noon to 12.30 p.m. The pressure in the mains while the tank supply is being delivered is about 30 lbs. per square inch. The pressure when water is being pumped directly into the mains is 25 lbs. during the day and 12 lbs. during the night. If, however, the drains and water mains are to be flushed during the night, the full pressure of 25 lbs. is kept up.

This water is obtained from three wells with three headings, two of the headings serving as connecting tunnels between the three wells. Comprehension of the relationships of these one to another, and of the historical description about to be given, will be facilitated by reference to the accompanying diagrams (Diagrams I. and II.).

The "Worthing" public service dates from 1857, when the well-shaft marked A in the diagram was sunk. This well, lined with iron

DIAGRAM I

BLOCK PLAN OF WORTHING WATERWORKS, ENCLOSURE AND ADJACENT PART OF TOWN.

1/833 feet to 1 inch.

W.H.

To Main Sewer

Infirmary drain

COOLING TANK

WELL C

TUNNEL to WELL B

TUNNEL to WELL A

POND

Chain pump well.
Sewage well

Abandoned about 1830

H ST

M.H.

PIPE FROM CONDENSER

PIPE FROM AIR PUMP

WELL A

WATER TOWER

ENGINE HOUSE

WELL B

ENGINE HOUSE

Iron cylinder well 6'0" dia. 104'.0" deep with 300'.0" Bore hole 14" dia.

Iron cylinder well 5'0" dia. 60'.0" deep with 300'0" Bore hole 14" dia.

INFIRMARY

LYNDHURST RD

Sewers now in use shewn thus.....

Sewers abandoned but not taken up shewn thus.....

.....taken up shewn thus.....

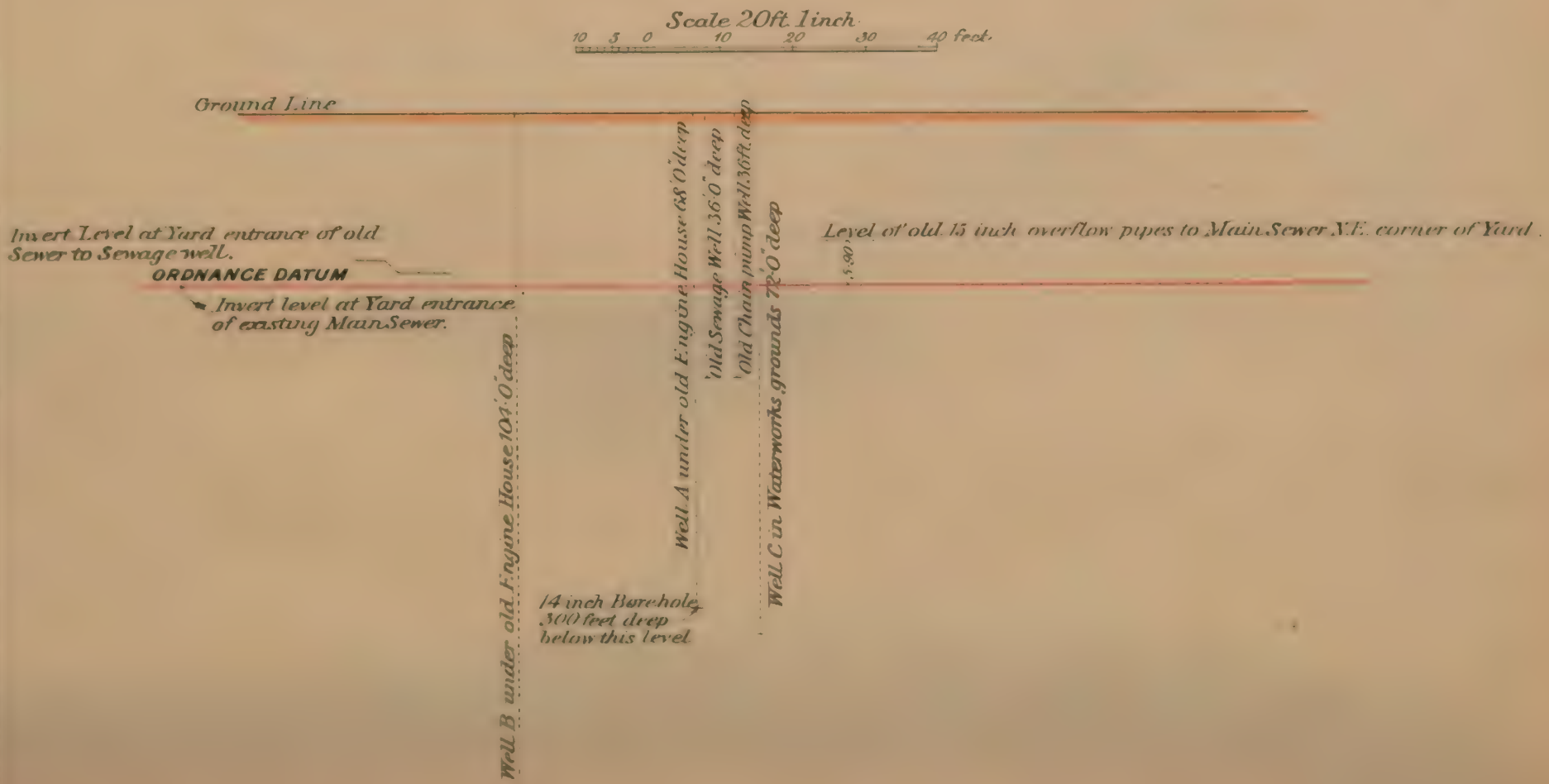
Wells Water Tunnels and water Pipes shewn in Blue

M.H. Manhole.

Wyman & Sons Lth. 63 Carter Lane

DIAGRAM II.

Section of Worthing Waterworks Enclosure indicating the relative depths of various structures shewn on Diagram I.


Scale 20ft. 1inch
10 5 0 10 20 30 40 feet.
Ground Line
Invert Level at Yard entrance of old Sewer to Sewage well.
ORDNANCE DATUM
Invert level at Yard entrance of existing Main Sewer.
Well B under old Engine House 104'0" deep
14 inch Borehole 300 feet deep below this level
Well A under old Engine House 68'0" deep
Old Sewage Well 36'0" deep
Old Chain pump Well 36ft. deep
Well C in Waterworks grounds 72'0" deep
Level of old 15 inch overflow pipes to Main Sewer N.E. corner of Yard.
5.80

cylinders, has an internal diameter of 5 feet, and is 68 feet in depth; and from the bottom of the well a 19-inch bore-hole proceeds for another 300 feet. It yields 4,500 gallons per hour, and constituted the sole public supply until 1867, when a second well-shaft, that marked B on the diagram, was sunk. This well (B), also lined with iron cylinders, has an internal diameter of 6 feet, and is 104 feet in depth; and from the bottom a 26-inch bore-hole proceeds for another 300 feet. It yields 9,000 gallons per hour. At the time when well B was sunk, it was connected with well A by a siphon; for which a tunnel was substituted in 1880. This tunnel is at a depth of 72·6 feet from the surface, and is 113·4 feet in length. It has an internal diameter of 6 feet by 4 feet, and is lined with brick in cement, a brick being omitted every 18 inches in the bottom row of each side to permit ingress of water. This tunnel yields some 2,000 gallons per hour. In 1885 the Corporation again sought to augment their supply, and with this view, commenced sinking another shaft in the north-east corner of the waterworks enclosure. But at a depth of only 18·6 feet from the surface (just before reaching the Chalk and in circumstances unfavourable therefore to the quality of the discovered water), so large a quantity of water * was encountered that the proposed sinking at this spot was abandoned, and another shaft was sunk, also in 1885, at a spot about 60 feet to the south-west of the abandoned shaft. The new well in this way provided is that marked C on the diagram. In sinking this well (C) a small amount of water was encountered about 20 feet from the surface, after which a gradual increase was noted until the excavations terminated. This well lined with brickwork in cement, is 72 feet deep, and has an internal diameter of 7 feet. It was not provided with a bore-hole, but a tunnel was constructed leading from well C to the tunnel connecting wells A and B. This tunnel is 72 feet from the surface, has a length of 234 feet, and internal dimensions of 6 feet by 4 feet, and is constructed similarly to the tunnel leading from well A to well B. The yield from this source and from well C (which supplies the major part) is 7,000 gallons per hour.

The quantity of water derived from these various sources, however, was again found to be insufficient for the increasing population of the district, and, accordingly, in the beginning of the year 1893 further supplies were sought for. With this view it was resolved to drive a heading in a north-easterly direction from the bottom of well C, and on March 13th this work was commenced. As the work proceeded several small fissures were encountered, and on April 13th, when the heading was 68 feet in length, the total yield was estimated at about 60 gallons per minute. On April 14th, at 2 p.m., a large fissure estimated as yielding 2,623 gallons per minute was cut into. The heading, of which the internal dimensions are 6 feet by 4 feet, and of which the structure is similar to that of the other tunnels, was at this time 70 feet in length. So sudden and so great was the inrush of water from the fissure now struck, that the men employed in the work of excavation had to forsake their tools and run for their lives. The additional water thus obtained was forthwith utilised for service to "Worthing" and Broadwater, and from this date forward the supply was derived from all the sources I have described.

The "West Worthing" Waterworks are the property of a Company and are situated in "West Worthing" on an enclosed piece of ground, which is rather more than two acres in extent. The position of this site is marked on Map 1. The soil here resembles that described under

* On making further excavations this water was seen to well up from a fissure at the surface of the Chalk at that point.

App. A. No. 6.

Thomson.

the heading *The "Worthing" Public Service.* The Company's water is obtained from two wells in the Chalk. One of these, stated to have been sunk in 1865, is an iron cylinder well, 32 feet in depth, and having an internal diameter of 12 feet. From the bottom of the well a bore-hole, 8 inches in diameter, proceeds to a further depth of 38 feet. The other well, said to have been sunk in 1887, is an iron tube well 130 feet in depth, and without bore-hole. Water is pumped from these wells at the rate of 20,000 gallons per hour, and pumping is usually carried on in winter from 6 a.m. to 11 a.m., and again from 2 p.m. to 5.30 p.m. In summer, pumping is from 6 a.m. to 5.30 p.m. with an intermission of one hour, viz., 1 p.m. to 2 p.m. There are no means of storage or filtration, and the supply, which is limited to "West Worthing" and West Tarring, is an intermittent one.

The remaining sources of supply in the four places, namely, supplies from *local wells*, need little description. Most of the wells are shallow and they are commonly dry steined; some few, however, are deep and well constructed.

Reference to Map I will show the distribution of the two public services throughout the four areas. The "Worthing" mains, which are limited to "Worthing" and Broadwater, are coloured blue; the "West Worthing" mains which supply water only to "West Worthing" and West Tarring, are coloured red. I have already stated approximately what proportion of these places are served by local wells; I now append in tabular form these facts in detail.

TABLE VII.

SHOWING for each of the Four Areas invaded by ENTERIC FEVER the Number of Houses obtaining water from one and another different Source of Supply.

Sanitary District.	Area invaded by Enteric Fever.	No. of Inhabited Houses.	No. of Houses on Public Service.	No. of Houses served by Local Wells
Borough of Worthing -	"Worthing"	2,890	2,879 ("Worthing" Service)	31
	"West Worthing"	347	326 ("West Worthing" Service)	21
East Preston Rural Sanitary District -	West Tarring Village	229	169 ("West Worthing" Service)	60
	Broadwater Village	191	65 ("Worthing" Service)	126

It is now, in the light of these fact, desirable to reconsider the data respecting the time incidence of the fever given in Tables V. and VI. and in the corresponding charts. Reference to Charts III. and IV. will show that the first fever case of the epidemic in "Worthing," attacked on April 16th, was followed in a few days by many more cases; and that in Broadwater the first case, occurring on April 27th, was followed by two further cases in May; whereas in "West Worthing" no case whatever of enteric fever occurred in either April or May, and

PLAN OF WATER MAINS: WORTHING; WEST WORTHING; WEST TARRING; BROADWATER.

Green Lines. *Boundary of Borough of Worthing.*
Yellow ,, ,, *Line between Worthing and West Worthing.*
Roadways.
Blue Lines in ,, *Water Mains of Worthing Public Service.*
Red ,, ,, ,, ,, ,, ,, *West Worthing Public Service.*
Blue irregular Area. *Worthing Water Works Enclosure.*
Red ,, *West Worthing Water Works Enclosure.*

In West Tarring one case only occurred (in early May) during these two months. With the exception, therefore, of this solitary case in West Tarring, to which I shall return later, every one of the cases (with which this report deals) commencing in the months of April and May occurred in "Worthing" or in Broadwater; moreover, as has already been noted, the further course of the epidemic in these two places was very similar.

These two places, "Worthing" and Broadwater, it now appears, possess to some extent a common water service, that, namely, from the "Worthing" Waterworks, from which are supplied almost the whole of "Worthing" and rather more than one-third of Broadwater village. If, then, the "Worthing" water service were the means by which enteric fever was disseminated throughout these two places, two results should follow, namely,—(1) That relatively to the total inhabitants in each area more persons should be found attacked by the fever in "Worthing," where there are few local wells, than in Broadwater, where there are many local wells; and (2) That persons in both places, residing in houses supplied from local wells, should be found to have suffered less fever than their neighbours who used "Worthing" water.

Of these expectations the first has been shown (at an earlier stage of this report) to have been fulfilled; "Worthing" people, as a matter of fact, suffered, relatively to the population in each instance, three-eighths more fever than Broadwater people. The second, therefore, now requires consideration.

In "Worthing" there are 31 houses supplied with water from local wells, and of the inmates of such houses eight were attacked; or one person per four houses. On the other hand 2,859 houses in the place are supplied with "Worthing" water, and of the inmates of these houses 1,249 were attacked; or one person per 2·3 houses. This smaller incidence on houses supplied by local wells tends, moreover, to be reduced still further when the facts as to the persons suffering fever in them are studied in detail. For of these eight persons it has been ascertained that four had frequently drunk "Worthing" water unboiled, and other two had drunk lemonade made with "Worthing" water. Whether or not the remaining two persons had used this water could not be definitely ascertained, but it is worthy of notice that the earliest of these remaining cases occurred in September, by which time the "Worthing" soil may easily have become so far fever-fouled as to expose the water in local wells to considerable risk of pollution.

In Broadwater, on the other hand, 19 out of a total of 65 houses on the "Worthing" Service were invaded by enteric fever; whereas of 126 houses supplied from local wells only in 12 did the disease break out. Thus in Broadwater the fever invaded one out of every 3·5 houses on the "Worthing" service, and only one out of 10 supplied by local wells. Similarly of the 267 persons who inhabited the 65 houses on the "Worthing" service, 27, or 10 per cent. were attacked; whereas of the 520 persons inhabiting the 126 houses supplied from local wells, only 14, or less than 3 per cent., suffered. But the contrast here between the two classes of houses and of persons is much more striking when, from those taken ill although residing in houses with local wells, there are deducted such as are known to have drunk "Worthing" water. Thus of the 14 Broadwater persons attacked by fever, notwithstanding that they lived in houses supplied from local wells, two were at service in and were brought home ill from "Worthing," and other two were at work daily in "Worthing." These four persons all of them admitted having drunk "Worthing" water unboiled, as also did three more of the 14. Of the remaining seven (of the 14) one was removed.

home ill from "West Worthing" where she was in service; two occurred in houses in which there had been previous cases; and one (a child) was subsequently declared by her medical attendant to be suffering not from enteric but from scarlet fever. The remaining three (of the 14) are unaccounted for. In this way it appears that of the 41 Broadwater cases no less than 34 had been in the habit of consuming "Worthing" water; one was not enteric fever, and as regards only six is there the statement that they had not before their illness used "Worthing" water.

It is evident, therefore, that there was comparative immunity from enteric fever of persons, whether in "Worthing" or in Broadwater, who habitually consumed water from local wells; and that there was heavy incidence of the disease on those who used the water delivered by the public service in these places.

But if the "Worthing" public service has been in fault, evidence should be forthcoming as to some alteration in its constitution parallel to the observed outbreak and maintenance of enteric fever among persons consuming it. In this aspect, the modification of this water service involved in the addition to it of water from a new source in April 1893, at once presents itself for examination. Accordingly it is necessary to consider in detail the relations between the provision of the new source of supply and the outbreak of enteric fever.

The first case of the epidemic in "Worthing" and Broadwater was notified on May 3rd, and was quickly followed by several others. Inquiry as to the actual dates on which all these persons first fell ill, established the fact that the first attack occurred on April 16th, the second on April 19th, and the third on April 21st. These, and one or two other cases occurring towards the end of the month, were followed, from April 28th onwards, by what may be called the main body of the first outbreak. But as will be remembered, the large fissure, from which by far the greater part of the new supply was drawn, was not cut into until April 14th; only two days, therefore, before the first of these attacks. This fact, notwithstanding that the incubation period of enteric fever may be shortened when water is the medium of transmission, is of a sort to raise doubt as to connexion between the admission of water from the fissure in question and the outbreak of the fever; and a fuller account has, therefore, now to be given of the proceedings that took place in driving the heading from which the new supply was, in the spring of 1893, obtained.

In my previous and more curtailed account I noted that the very large yield from the fissure struck on April 14th was at once utilised. But I did not state what became of the water, relatively small in amount, which had been encountered in the new heading prior to April 14th, and this I now do. Before excavation of the new heading was commenced, a sluice valve had been fixed in the tunnel leading from well C to the tunnel between wells A and B. This sluice valve, which was fixed in the tunnel near its departure from well C, was intended to prevent water from well C, inclusive of water from the new heading, gaining access to the public service during progress of the new works; since these were necessarily of a nature to cause some turbidity of the water in well C. The fixing of this sluice-valve was completed on March 11th, and on March 13th excavation of the new heading was begun. The heading was driven during the day-time and lined with bricks in cement each night. Meanwhile the water derived from the new heading in course of excavation, with that from well C, was to be pumped up and either discharged on the surface of the waterworks enclosure, or utilised for street-watering and sewer-flushing. But the

water in question was not entirely thus disposed of, for the pump again and again became blocked (owing, it is said, to carelessness on the part of the brick-workers at night); and when this happened the sluice-valve was opened, and the accumulated water allowed to pass into the public service. Further, whether or not the pump was in working order, all water that accumulated in well C on Saturday afternoons and on Sundays was allowed access to the public service. So that the inhabitants of "Worthing" were drinking water in small amount from the new heading for some days before April 14th. The yield from the new heading prior to April 14th, estimated, it will be remembered, at 60 gallons per minute, was derived, it is not unimportant to know, according to Mr. Harris the water engineer, mainly from a small fissure cut into on April 7th, when the heading was 53 feet long.

In view of these facts it may be inferred—given infective quality of the water encountered in the new heading—that the few straggling cases that occurred between April 16th and 22nd may have been infected through the medium of the small quantity of water intermittently added to the public service from this heading at a period antecedent to April 14th. The main outbreak, however, of late April and early May, occurred, as shown in Charts III. and IV., a fortnight to three weeks after the date on which the large fissure was cut into; that is, not until water from this new source had some time constituted a considerable proportion of the total supply. The incubation periods in this way indicated, alike for the initial cases and for cases included in the epidemic outburst in May, are accordingly altogether consistent with the total fever during April and May, in "Worthing" and Broadwater, having been due to infection conveyed in the water derived from this new heading.

[But, while these facts are such as not merely to harmonise with a theory that the "Worthing" public service acted as the medium of infection, but even to cast upon that service the most serious suspicion, a small amount only of the enteric fever prevalence in "West Worthing" and West Tarring, the other two invaded areas, is susceptible of similar explanation. For, as has been shown, no part of either of these places receives water from the "Worthing" public service.

As regards the earlier cases in these localities, indeed, much the same history was obtained as in regard of those persons in "Worthing" and Broadwater, who, notwithstanding that they resided in houses supplied by local wells, nevertheless suffered fever. Thus, in West Tarring, the person attacked in early May was a domestic servant in "Worthing" who was taken to her home in West Tarring after she had fallen ill. Similarly every case (except two) known to have occurred in West Tarring up to the end of the second week in July, either had resided in "Worthing" and gone home to West Tarring on falling ill, or was at work daily in "Worthing" and had drunk unboiled water there. Of the two exceptions, one had drunk aërated waters manufactured in "Worthing": the other is not to be thus accounted for. So, too, as regards "West Worthing," of the first six persons attacked (up to and inclusive of an attack on July 20th), four had drunk unboiled "Worthing" water: the two others could not be thus accounted for. There can be no question, therefore, that the occurrences of the disease in "West Worthing" and West Tarring up to mid-July are to be regarded as part and parcel of the outbreak in "Worthing" and Broadwater. But the cases that occurred in these places in the latter part of July and the early portion of August require altogether different explanation. None of these persons are known to have drunk "Worthing" water. Here, then, we have at "West Worthing" and West Tarring, outbreaks,—

later than the "Worthing" and Broadwater outbreak, but themselves concurrent in point of time—which are not to be explained on a hypothesis that the "Worthing" water had been acting as the distributing agent of the enteric fever. The consideration of the causation of these two outbreaks will be resumed later.

Broadwater and West Tarring;

As to the fever in "Worthing" and in Broadwater, which has been provisionally referred to the "Worthing" water supply, the question arises whether any circumstances have transpired pointing to the possibility of this service, especially the section of it which has appeared to be implicated in the fever, having been exposed to dangerous pollution.

The "Worthing" waterworks are on all sides surrounded by inhabited houses which drain into the "Worthing" sewers. Reference to the previously given diagrams (Diagrams I. and II.) will show the relation of the waterworks to the more important sewers in the neighbourhood; and also it will be seen from these diagrams that on the site itself there exist certain sewage arrangements now disused. These are deserving of particular consideration.*

The sewerage arrangements, now disused, in the waterworks enclosure, date back to the time when "Worthing" sewage was delivered in the enclosure by the main sewer (entering it from the High Street, which lies to the west of the waterworks) into two brick tanks. These tanks, shown on the diagrams, were each 36 feet in depth, and their contents used to be pumped to a sewage farm, or into a neighbouring watercourse, known as the Teville Stream. The tanks, marked respectively "sewage well" and "chain pump well," were connected at their bottom by a 15-in. pipe. From the "sewage well" two carriers passed in a south-easterly direction out of the waterworks enclosure. One of them was a 15-in. stoneware pipe, the other a 12-in. rising main made of iron; and by both sewage was conveyed to the sewage farm. These pipes were about 2 feet below the surface of the ground. From the "chain pump well" three 15-in. storm overflow pipes passed side by side in a north-easterly direction out of the enclosure: two of them discharged into the Teville Stream, while the third discharged into the Park Road sewer. These pipes were constructed of earthenware, and were laid side by side at a depth of about 15 feet from the surface. In 1880, sewage pumping at the waterworks having been brought to an end, the sewer from High Street was bricked across at two points; one within the waterworks enclosure, the other in the street outside; the "Worthing" sewage from this time being made to pass along the new main sewer shown by a red line running north-east on the west side of the enclosure. At the same time the sewage tanks within the waterworks enclosure were filled up with earth. The carrier pipes, however, passing from the "sewage well" to the (now disused) sewage farm, although rendered useless, were nevertheless left undisturbed; and they remained so until September 1892, when those portions that lay within the waterworks enclosure were taken up. Meanwhile the three overflow pipes from the "chain pump well" had been, in 1885, blocked up at the north-east corner of the enclosure. The method employed in thus dealing with them consisted in taking up about 10 feet of the piping, and building a wall of bricks in cement across each end thus exposed, and filling in the space between the ends with earth. Accordingly, in April 1893, none of these structures had for 13 years been in use for

* The diagrams show the water and sewerage arrangements on the site and in its neighbourhood as they were on April 14th, 1893, when the new water supply was struck.

dealing with sewage, though the three overflow pipes from the "chain pump well" remained, save for a length of 10 feet in each instance, intact. As before, two of them passed into the Teville Stream, while the third remained connected with the Park Road sewer. In the summer of 1893, when these overflow pipes came to be examined, they were found, at various points between the north-east corner of the waterworks enclosure and Park Road, cracked and broken; and they permitted leakage of their contents into the surrounding soil.* The particular pipe connected with the Park Road sewer had, between the waterworks enclosure and Park Road, a fall of about a foot, the exact levels being as follows:—

†In waterworks enclosure near well C	-	5·90 ft. above O.D.
†A few yards outside north-east corner of enclosure - - -	-	5·38 ft. " "
†At junction with Park Road sewer	-	4·86 ft. " "

If these data be accepted as correct, backing-up of sewage through the Park Road sewer into this overflow pipe from the "chain pump well" need not, in view of the borough surveyor's experiments, quoted on p. 55 of this report, occur under ordinary circumstances; but it almost certainly would occur when heavy rainfall coincided with a tide-locked condition of the sewers. Under these conditions sewage would pass up out of the Park Road sewer along this pipe to the spot at the north-east corner of the enclosure where it was blocked; and would necessarily, owing to the leaky state of the pipe, escape into and pollute the surrounding soil. Sewage pollution of the soil, accordingly, might have occurred in this way, at least up to a point within 30 feet of the spot beneath which lay in the Chalk the new heading made in 1893.

But this overflow pipe-sewer is not the only sewer near the water works enclosure, which, on examination made in the summer of this

* All these pipes contained solid deposit, but it was of different character in each. The pipe connected with the Park Road sewer was about half full of moist sediment, which was of black colour throughout; the pipe lying next to it was about three-quarters full of dry sediment, black on top and of grey colour elsewhere; and the third pipe contained a deposit about two inches only in depth, black on the surface, but white underneath and evidently composed of chalk. In view of the extent to which the "Worthing" sewers back-up, it would follow that when this took place in wet weather the pipe connected with the Park Road sewer might fill with sewage, whereas the pipes going to the Teville Stream would not. It might, indeed, be held that the presence of sewage in the pipe connected with the Park Road sewer is indicated by the character of its contents; and that the tainted but less foul character of deposit in the adjacent pipes is explicable by leakage from the Park Road sewer pipe, contaminating the contents of the other two, of which the nearer showed most pollution. This different condition of contents of the overflow pipes, however, was found to obtain also in the case of those portions of them left in the waterworks enclosure, which were cut off in 1885 from the remainder of the pipes. The condition of their contents, therefore, cannot with probability be attributed to recent backing-up of sewage. A more probable explanation of the condition of their contents is found in the fact that in 1885, prior to the blocking of these pipes at the north-east corner of enclosure, the water obtained from well C, then in course of construction, was pumped into one of these overflow pipes by which it was carried off. The pipe into which this water passed was the one now containing a clean chalky deposit; and, if it be assumed that the contents of all these pipes had formerly been black, it is conceivable that this water cleansed the pipe into which it discharged, and to some extent affected also the pipe lying next to this, to which it would gain partial access owing to the broken condition of these pipes. These considerations, however, do not militate against the conclusion, based on the data provided by the borough surveyor of Worthing, that occasional backing-up of sewage would take place along the overflow pipe connected with the Park Road sewer.

† These measurements are from O.D. level to the invert of the pipe in each instance.

year, was found to be defective and permitting leakage into the soil. Another such was the Park Road sewer itself. This sewer, constructed of 12-in. stoneware pipes jointed with clay, permitted leakage at several points, some of its joints gaping widely. It lies parallel to the east side of the waterworks enclosure at a distance therefrom of 150 feet, and is at its nearest point some 160 feet from the spot under which lies the extremity of the new heading. In addition, to the west of the waterworks enclosure lies a 3-ft. brick barrel main sewer, some 210 feet distant from well C, and some 250 feet from the extremity of the new heading. This sewer was also found to be in a leaky condition near the waterworks enclosure. Since it lies at a considerably greater depth than either of those already referred to, it is full of backed-up sewage when tide-locked; that is to say, twice every 24 hours.

It is sufficiently obvious, therefore, that the soil overlying the Chalk in which were sunk the wells and headings furnishing the water supplied to "Worthing" and Broadwater, was liable to sustained pollution, by sewage. It does not, of course, necessarily follow, because the overlying soil was thus liable to pollution, that water taken from headings deep below in the chalk would likewise be liable to dangerous pollution. Such pollution would, however, be very likely to occur if surface-water were to readily gain access through the Chalk to the water below, and there is reason to know that free communication did, as matter of fact, exist between the soil above the Chalk and the new heading in the waterworks enclosure. It will be remembered that in the description given, at an earlier stage, of the "Worthing" waterworks, reference is made to the fact that in 1885 a shaft that was being sunk near the north-east corner of the enclosure had to be abandoned owing to the large amount of water of very doubtful quality that was encountered within 18·6 feet of the surface. The water in this experimental shaft was at the time observed to well up from a fissure in the Chalk; and this fissure was situated almost directly over the spot to which the new heading had been driven when the large inrush of water of April 14th, 1893, was encountered.

With the view, therefore, of ascertaining whether or not the fissure in question communicated with the new heading, I caused the old shaft of 1885 to be re-opened to a depth of 22 ft.; and into this re-opened shaft I had thrown, on August 17th, a ton of salt in solution. A sample of the water contained in well C was taken just before the salt solution was thrown down the shaft, and afterwards samples of this water were taken at intervals on the same and on the two following days. These samples were subsequently chemically analysed for chlorine. The addition of the salt solution occupied a period of an hour and a quarter, viz., from 11.30 a.m. to 12.45 p.m., and by 1 p.m., as will be seen by reference to the figures set out in Addendum A., the chlorine in the water of well C had enormously increased, while it had returned to its usual proportions a few hours later.

This experiment suffices to indicate that the fissure at the bottom of the abandoned shaft freely communicates with the new heading,* and it is evident that, given contamination by sewage of the ground above and in the neighbourhood of that fissure, dangerous material could readily gain access to the public water supply. Had circumstances

* This was subsequently confirmed in another way. In the course of some diving operations in the new heading at a later period, it was observed that air bubbled up through the water standing in the bottom of the abandoned shaft, and that this phenomenon was repeated wherever the divers were at work at the extremity of the new heading.

permitted, similar experiments would have been conducted with the overflow pipes from the chain pump well and with the Park Road sewer. But, owing to a misunderstanding of earlier instructions given, a considerable length of these pipes had been already removed, and the ground filled in; and with the result that the conditions were so much changed from those prevailing in April, that the value of experiments in this direction would have been open to much doubt. However this may be, it is now abundantly evident that opportunities for dangerous pollution of the "Worthing" water supply were not lacking, and it remains but to note the actual condition of this water as shown by chemical and by bacterioscopic examination.

Several chemical analyses of the "Worthing" water before as well as after the date on which the new supply was utilised, are given in Addendum B., and from these it will be seen that, as not infrequently happens, chemistry failed to detect any definite impurity in the water. But the results of bacterioscopic examinations, given in Addendum C., furnish conclusive evidence of contamination of this water supply by fœcal matter. In a sample taken from well C on July 26th, and submitted to examination on July 27th, there was found a considerable amount of bacterium coli, a certain index of fœcal pollution. Again, on August 8th, another sample was collected drop by drop during a period of 24 hours from the rising main which distributes to "Worthing" and Broadwater water from the combined sources of the "Worthing" waterworks. This sample was submitted to examination on August 9th and in it was found the enteric fever bacillus, as well as abundance of the bacterium coli.

Thus the chain of evidence against the "Worthing" water is complete. It has been shown that the epidemic of enteric fever in "Worthing" and Broadwater was intimately related in point of time to the admission to the "Worthing" service of water from a new source of supply; that thereafter the disease became general throughout the areas supplied by this service; and that within the limits of these areas the incidence of fever was almost wholly on houses supplied by this water. Further, it has been shown that certain apparent exceptions to this rule, were, for the most part, persons who had elsewhere consumed the water in question. And now it appears not only that this new source of water supply was open to dangerous contamination, but also that, by the aid of bacterioscopic examination, demonstration is forthcoming of such contamination having actually occurred.

Attempts to ascertain whether specific infection from a previously known case of enteric fever in the district might have gained access to the water supply were unsuccessful. Only two cases notified as enteric fever occurred in "Worthing" in 1893, prior to the prevalence at the end of April. One of these died in the infirmary on January 17th, of what was certified to have been typhoid fever and pneumonia. But this date is three months anterior to the outbreak now being considered, and it is difficult to suppose that here is to be found the source of the outbreak. Moreover, it would seem that doubts exist as to whether this was in reality a case of enteric fever. The other case of enteric fever was one that proved fatal on February 20th, in West Buildings, "Worthing." This person was throughout her illness treated at the place above named. Sewage from that house would, on its way to the outfall, pass along the main sewer lying to the west of the waterworks enclosure, which sewer, it will be remembered, was found to permit leakage into the surrounding soil. But this case also occurred at an interval sufficiently distant to justify hesitation in accepting it as a probable source of the subsequent outbreak. Dr. Kelly, the Medical Officer of Health for the district, has suggested that excremental fouling

of the new heading by workmen employed in its excavation, a fact of which he possesses evidence, may have been the cause of the April and May outbreak. No evidence, indeed, is forthcoming that any of the workmen employed were at that time suffering from enteric fever, though of course it is not to be denied that slight and "ambulant" attacks of the disease are not always recognised. However this may have been, the sudden multiplication of attacks in the beginning of July, may, with some probability, be attributed to pollution of the water supply on a large scale by infective material, derived from the cases of the April and May outbreak. The excreta of almost all these persons would, like those of the fatal case of February 20th, pass along the leaky main sewer that lies to the west of the waterworks enclosure; and, in addition, it has to be borne in mind that the defective Park Road sewer, which was connected with one of the overflow pipes previously referred to, received the infirmary sewage. In the months of May and June, a large number of persons suffering from enteric fever were admitted into and treated at the infirmary. Into this institution were admitted 27 cases during May, 14 during June, and 9 during July. No cases of enteric fever were admitted after July 9th. The Park Road sewer was reconstructed in June, but up to June 26th the old sewer remained in use. Accordingly up to this date, enteric excreta were passing along a defective sewer situated on the east side of the waterworks enclosure, in addition to the enteric excreta passing along the west side in the main sewer already referred to.

There still remain for consideration the fever-prevalences in "West Worthing" and West Tarring, both of which developed, it will be remembered, long after the epidemic had become established in "Worthing" and Broadwater. Each of these other fever-prevalences —in "West Worthing" and in West Tarring respectively—is divisible, as will be seen from Table VI. and Chart IV., into two series of cases consisting:—

(1.) Antecedent to mid-July, of a series of earlier cases, few in number and irregularly distributed in both places, but tending chiefly to affect one particular locality in each.

(2.) During, and in weeks subsequent to, mid-July, of a considerable outburst of fever almost entirely localised in "West Worthing" and West Tarring, in that section of each of these areas which had already especially suffered from the malady.

The first series, *i.e.*, antecedent to mid-July, has already been accounted for; the persons attacked during that period, whether in "West Worthing" or in West Tarring, having almost without exception become infected in "Worthing." It is the outbursts constituted by the second series of cases in "West Worthing" and in West Tarring respectively, that require explanation, and for the following reasons:—

(*a.*) They were found not to be directly referable to antecedent fever either in "Worthing" or in their own localities.

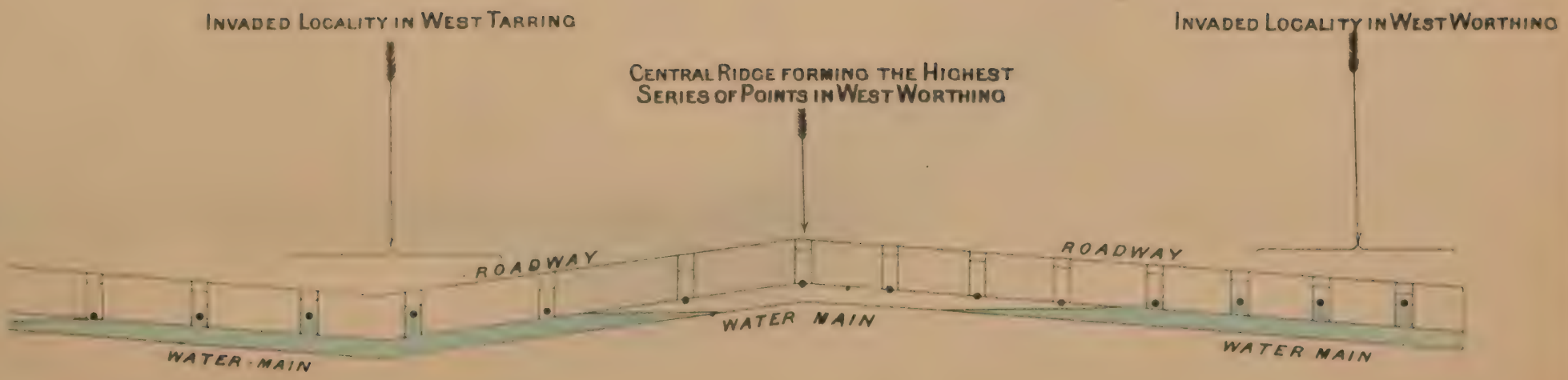
(*b.*) They were not attributable, as has already been shown, either to defective general sanitary circumstances or to infective emanations from sewers or drains.

(*c.*) Milk supply, as has been shown in a previous section of this report, did not aid in the dissemination of this fever.

(*d.*) They could not be considered, if regard be had to the escape of large sections of each locality, referable to water supply, unless limited areas of their common water service can have become infected simultaneously by separate (or preferably by a single) fever agency.

There are, however, certain facts in connexion with the "West Worthing" water service, *which is, as just stated, common to the two*

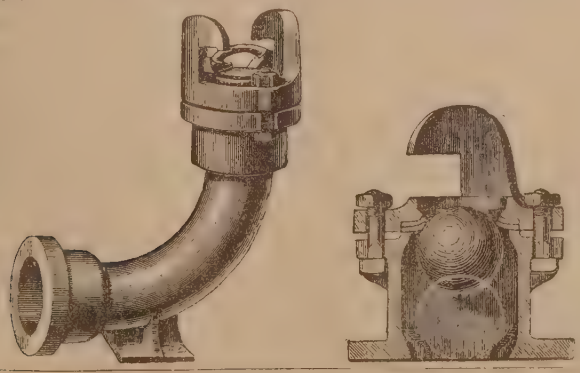
Diagram III.



The upper horizontal line of the diagram represents the roadway surface: the space between the two lower horizontal lines represents the water-main. Each pair of vertical lines corresponds to a street hydrant, the hull of the hydrant being always represented by a black dot. The level of the water in the mains when the service has been some time intermitted, is shewn by blue shading.

places, that tend to throw some light on the matter. These facts in no way throw discredit on the water at its source, which, as has already been stated, is the Chalk below the town, the water being pumped from a couple of wells furnished with bore-holes. Chemical analysis of this water (*see* Addendum B.*) has invariably attested its purity, and no change has been made in the source of the supply during several years. Moreover, such enteric fever as has in other years occurred in the area supplied by this service has never been distributed in fashion suggestive of contamination of the water supply as a whole. If, therefore, the "West Worthing" water is to be thought of as concerned in the localised fever witnessed in 1893 in "West Worthing" and West Tarring, there is almost involved a presumption that this water supply became contaminated after withdrawal from its source; namely, in the mains of the water company. And there is, to say the least, possibility that specific infection in this sense of these water mains, or some of them, may have occurred in 1893; as will be seen from the considerations that follow.

The conformation of the ground in "West Worthing" is such that its highest points are to be found along a ridge which runs through it from east to west. This ridge is to the north of a line drawn east and west through the centre of the place. From this ridge the ground slopes gently on one side to the south and on the other to the north. Most of the houses in "West Worthing" lie on the south of this ridge; and all the houses in West Tarring to the north of it. The water mains follow the contour of the ground. As the "West Worthing" water supply is usually intermitted for a considerable interval of time between the afternoon of one day and the morning of the next, the higher portions of the water mains tend to become emptied as the water flows down into the lower portions of the service. I have satisfied myself by personal inspection that this condition may exist, and the accompanying diagram (Diagram III.) illustrates this state of things. The invaded area in "West Worthing" is at the lowest inhabited point of the slope on the southern side of the ridge; the invaded area in West Tarring is at the lowest point of the slope on the northern side. If, then, any infective material were to gain access to the higher "West Worthing" water mains it would, under the conditions described, gravitate to these two areas, and tend to lodge in the water mains there. Owing to the kind of street hydrant with which nearly all mains on the "West Worthing" service are fitted, the contained water is especially liable to risk of pollution from matters cast on the roadway. The prevailing pattern of hydrant is that known as the "ball-hydrant," of which illustrations are annexed.



* Not reproduced.

This hydrant consists of an iron pipe which communicates with the water main below, and in which is enclosed an ebonite ball. This ebonite ball is driven by the pressure of the water below up against a flange lined with india-rubber, and when thus situated prevents egress of water and ingress of foreign material. The whole is enclosed in an iron box with keyhole. The interior of the box not infrequently contains filth which has gained access by the keyhole of the hydrant box. When the pressure in the main falls below a certain amount, stated to be about 6 lbs. per square inch, the ball drops, and filth from the hydrant box or from the roadway may readily pass into the water mains. I ascertained by actual inspection at a time when the engines had for several hours ceased pumping, that the balls in the hydrants of the "West Worthing" service actually had dropped in the majority of instances, and that fouling of water in the mains below was thus rendered possible. Infective material, therefore, might in this way have gained access to the mains of the "West Worthing" water service, near the summit of the ridge above referred to, and might then, owing to the conditions that I have just described, have especially affected the two localities in which the disease was found chiefly to have prevailed. As a matter of fact, there was in 1892 a small outbreak in "West Worthing" and West Tarring which was localised in much the same way as the outbreaks now under discussion, and which Dr. Kelly, in his report on that outbreak, attributed to infection of water mains through ball hydrants.

With a view of ascertaining whether the water in the "West Worthing" water mains differed bacterioscopically from the same water at its source, samples of the supply were submitted to Dr. Klein from the rising main at the waterworks, and from a tap in Brunswick Road, a street situated in that section of "West Worthing" where there had been exceptional prevalence of fever. Unfortunately, however, this was not done until August 21st, when the acmes of the fever outbursts in "West Worthing" and West Tarring were past; and, whether for this or for other reason, the result of Dr. Klein's examination of the water was negative. Neither in the water from the rising main, nor in that from the main situated in the fever-invaded section of "West Worthing," was either the enteric fever bacillus or the bacillus coli discovered. (*See* Dr. Klein's report in Addendum C.) But while this bacteriological evidence fails to afford confirmation of the belief that specifically infected material had gained access to the "West Worthing" water supply, it cannot be held as proof that this water was free from infection at the time when fever was most prevalent (during the period mid-July to mid-August) in the invaded areas, nor, indeed, that it (or some of it) was not specifically polluted at the time when the samples were collected. For specific organisms are usually present in water in small amount only, and may readily be absent in small samples selected for examination out of the total bulk of water.

Upon a balance of considerations I incline to belief that the fever outbursts in "West Worthing" and West Tarring, during the period mid-July to mid-August, and in subsequent weeks, are referable to localised infection of water mains in the invaded sections of these places.

In what particular way the water in the "West Worthing" water mains may have become specifically infected there is not sufficient evidence to show. It has been suggested that the "West Worthing" and West Tarring outbreaks might be explained by the fact that during a few days in July and August 1893, the "West Worthing" streets were, for the first time for 2½ years, watered with "Worthing" water. This step was taken owing to an unusually heavy drain on the "West

Worthing" supply, which was being utilised to fill with drinking water tanks scattered about "Worthing." It is easy to see that if the "Worthing" water used to water "West Worthing" streets contained infective material, contamination of the "West Worthing" water supply would readily take place when the balls of the hydrants had dropped during intermission of water pressure in the mains; and that "Worthing" water distributed by water carts along the crown of the ridge before described, would gravitate during intermission of the "West Worthing" service to the lowest points of the water mains in "West Worthing" and West Tarring respectively.

There is, however, some discrepancy in the evidence as to the exact date on which "Worthing" water was first employed in this way. The foreman, whose duty it is to look after street watering, maintains that "Worthing" water was thus used for the first time on July 28th, whereas the "West Worthing" waterworks' books show that no "West Worthing" water was used for street watering from July 25th to August 8th, both dates inclusive. There was no rain on the 25th or 27th July to render street watering unnecessary. But even assuming the 25th to have been the date on which the "Worthing" water was first employed for street watering, the circumstance of its employment cannot be considered as accounting for the earlier part of the outbreak, *i.e.*, that on July 27th and days following, unless, indeed, the incubation period in these earlier cases was more than ordinarily brief.

Examination of the rainfall register suggests that possibly infective matter may have been washed during a rain-storm into the mains when the hydrant balls had dropped from lessened pressure. It was noticed that there was heavy rainfall about the 15th and 16th July, that is, some 12 days before the commencement of the outbreak, and at a time, therefore, consistent with relation of cause and effect between the exceptional rainfall and the outburst of fever in "West Worthing" and West Tarring. A considerable amount of rain fell also on July 19th and 20th, and again on July 23rd.

The conclusion to be arrived at on the whole of these facts is that the subsidiary outbreaks in "West Worthing" and West Tarring resemble the outbreaks in "Worthing" and Broadwater in their having been due to infective material which gained access to and was distributed by the water service. But they differ from the manifestations of the disease in "Worthing" and Broadwater in so far as they were not general throughout the whole of "West Worthing" and of West Tarring, but were almost entirely limited to two localities in these areas; and they differ also in that the evidence points rather to local infection of water in the mains than to pollution at its source, as was the case with the "Worthing" service. How the infective material of enteric fever gained access to the "West Worthing" water mains there is not sufficient evidence to show.

Action taken by the Town Council of Worthing as Urban Sanitary Authority.

In view of the outbreak of fever in May 1893, a special meeting of the Sanitary Committee was held on the 15th of that month, and the following recommendations were made, viz.:—

"(*a.*) To empty, cleanse, and hot limewash the reservoir on the top of the water tower.

"(*b.*) To cleanse and flush out the water mains, hydrants, and dead ends of mains.

"(*c.*) That notice be given to the inhabitants, by placards and by advertisement in the local papers, to boil all water and milk previous to use.

"(*d.*) To flush the house drains and sewers.
"(*e.*) To disinfect excreta of infected patients.
"(*f.*) To provide hospital accommodation, and nurses to attend the sick.
"(*g.*) To submit samples of water to bacteriological analysis.

Consequent on these resolutions the following steps were taken, viz.:—

The reservoir on the top of the water tower was emptied, cleansed, and hot limewashed during the night of the 15th–16th May. This procedure was repeated on June 1st and on September 22nd. The work of placing hydrants at all dead ends of water mains not already provided with these was begun on May 15th. On the same date the water mains were flushed and the hydrants blown out. This flushing of water mains was frequently repeated every day for a fortnight, and at occasional intervals up to the end of November. Besides the publication of warning advertisements in the local papers, a card was sent to each house in the borough cautioning the inhabitants against the use of unboiled water or of unboiled milk. Printed notices and handbills containing similar instructions were freely distributed on several occasions. Samples of water were taken and sent to Professor Crookshank, King's College, London, for bacterioscopic examination, as follows:—

From well C, May 16th (this was broken in transit).
From tank, May 15th.
From well C, May 22nd.
From well C (two samples), June 5th.

At subsequent dates the following further steps were taken in connexion with water supply:—On June 17th a circular letter was sent to all owners of property and house agents in the borough, requesting that all drinking water cisterns should be cleansed and wiped dry. In the case of empty houses this was required to be done forthwith. Tanks for a special supply of water for drinking and cooking purposes were placed at convenient points in the streets on July 18th. At this date, and for some time afterwards, water was supplied to these from the "West Worthing" waterworks.

On July 29th, under direction of the Sanitary Authority, an attempt was made by a skilled diver to close the fissure in the new heading from well C at the Worthing waterworks, but without success. A second and more carefully considered attempt was made on August 23rd by two experienced divers, but this also failed. The object in view in making these attempts to close the fissure was the exclusion from the "Worthing" public service of the water contributed thereto from this fissure. In this way it was hoped that further pollution of the public water supply would be avoided.

Steps were also taken with the view of acquiring a new and pure water supply of a permanent character. To this end, and in consequence of an application made by the Worthing Corporation for loan of 3,000*l.* for preliminary expenses in connexion with works of water supply, a public inquiry was held at Worthing on August 1st by the Board's Engineer Inspector, Mr. Arnold Taylor. At the inquiry it appeared that the source of such new water supply had not yet been decided on, and up to the beginning of 1894 no definite scheme of works for a permanent water supply had been submitted by the Sanitary Authority to the Board.

Meanwhile a shaft was sunk in the Chalk near the village of Broadwater, from which, it was hoped, a temporary supply would be obtained sufficient in amount to enable the Worthing Corporation to entirely

and at once dispense with the existing polluted public service. From September 4th onwards the street tanks, before referred to as furnishing the inhabitants with a special supply of water for drinking and cooking purposes, were filled with water from this new well near Broadwater; and on September 22nd these Broadwater works had so far progressed that it became possible to pump the new supply into the mains of the "Worthing" public service. Since September 22nd, therefore, the polluted supply has been entirely replaced by the Broadwater supply. For a time, however, the street tanks still continued to be filled from the Broadwater new well, the water in the mains, which had not as yet been disinfected, being supplied chiefly for drain-flushing purposes; but, according to Dr. Kelly, the Medical Officer of Health for the borough of Worthing, many persons probably took their water direct from the mains for drinking and cooking purposes. The provision of this temporary supply of water from the Broadwater well was due to the energy of Mr. Alderman Cortis, a member of the Worthing Sanitary Authority, at whose cost, indeed, the necessary initial works were taken in hand. Later, with the view of disinfecting the water mains of the "Worthing" service these were, on the evening of October 21st, charged with lime-water, and were kept so charged during the two days following.

Isolation of Persons attacked by Enteric Fever.—In the absence in Worthing of hospital accommodation for infectious diseases, the following special arrangements were made for the isolation of cases of enteric fever:—On May 16th the Committee of the Worthing Infirmary set aside nine beds for the treatment of enteric fever, and on May 19th two hospital tents, each containing eight beds, were erected for the same purpose in the infirmary grounds. The following places were subsequently converted temporarily into hospitals for the reception of enteric fever, namely:—On July 7th, the Richmond Convalescent Home; on July 12th, the Newland Road Mission Room; on July 15th, the Lyndhurst Road Primitive Methodist Chapel; on July 17th, the "Travellers' Rest" lodging-house; on July 18th, the "Retreat," High Street; on July 26th, Mr. Ralli's private hospital on Marine Parade. In all 422 enteric fever cases from the borough of Worthing were admitted into one or other of the foregoing institutions. A staff of nurses was engaged for each of these places, and, in addition, the Nursing Association provided, at the expense of the Worthing Corporation, nurses to attend the sick at their own homes. Pony carriages were used to convey these nurses from house to house; and in this way persons treated at home were visited at least once and frequently twice each day.

Convalescents.—Accommodation for convalescents from all invaded areas was provided in homes temporarily taken at Goring, Findon, as well as at Chichester House and Milton House, Worthing. Expenses in connexion with these homes were met by the "Mayor's Sick and Poor Fund."

Disinfection.—Infected rooms found to be overcrowded or in a dirty state were fumigated with sulphur and afterwards cleansed and white-washed. Disinfectants were supplied gratis to inhabitants of the borough from May 8th to the end of August. After the latter date they were supplied to the hospital institutions only.

Drain flushing.—During continuance of the epidemic special gangs of men were employed in flushing, by means of fire-hose attached to street hydrants, the drains of houses invaded by fever. This was done daily in the majority of cases and at least three times weekly in the remainder.

Action by the East Preston Rural Sanitary Authority.

Similar precautions in the matter of warning inhabitants against drinking unboiled water or unboiled milk, and as regards disinfection and drain flushing, were observed in the villages of West Tarring and Broadwater. These places are devoid of hospital accommodation for infectious diseases and accordingly the following temporary arrangements were made. At West Tarring the Public Reading Room was on July 14th utilised for the reception of cases of enteric fever, and on August 9th the Infants' School was devoted to the same purpose. In all 32 patients were thus accommodated. At Broadwater the Public Reading Room was, on July 20th, employed for the reception of cases of enteric fever, of whom 22 were in this way accommodated.

The history that has been set forth of the severe outbreaks of enteric fever in the four areas of "Worthing," "West Worthing," West Tarring, and Broadwater, adds one more instance to the already lengthy list of examples of the disastrous consequences that may result from a specifically polluted public water supply. From it as matter of first instance and of chief importance, the several Sanitary Authorities should learn the necessity of supplying a water pure at its source and free from risk of pollution after collection and during delivery. To fulfil this end they cannot display too great energy in pushing on the works necessary for the provision of a pure supply of a permanent character. The present supply procured from the well near Broadwater village, while undoubtedly preferable to that which it has replaced, is nevertheless not one that can be regarded as beyond risk of contamination. It is too near the village of Broadwater and to other human habitations to be beyond suspicion of pollution. And indeed certain bacteriological analyses that have been made of the water supply by Dr. Klein, and of which an account is given in an addendum to this report (Addendum C.) suffice to show that the water contains impurities which are of a character raising suspicion that it may in its turn become specifically polluted so as to distribute disease throughout the area of its supply. It is therefore most desirable that a water of undoubted purity should be made available for use as soon as possible. Further, the avoidance of risk of local pollution of water mains should be a matter of the most serious care to the Sanitary Authorities of the districts concerned. That this is liable to occur in the case of an intermittent supply delivered through mains fitted with ball hydrants is unquestionable; and accordingly this matter should receive most careful consideration.

The sewerage arrangements of the several areas dealt with in this report are very unsatisfactory. In addition to the defective condition of many sewers in "Worthing" and "West Worthing," due to faults of construction and to insufficient fall, the two systems of sewers which serve "Worthing" "West Worthing" and West Tarring are tide-locked, and consequently sewage backs-up in them during large part of the 24 hours. In Broadwater, again, there is no proper system of sewerage at all; such drainage as exists being into cesspools or into fields and ditches. It is the duty of the respective Sanitary Authorities to remedy these defective conditions without delay. The need for action of this sort has been recognised by the Worthing Town Council who have made applications to the Board for sanction to a loan of 36,300*l.* for works of sewerage. Inquiry as to the matter of this application was on December 14th, 1893, made at Worthing by the Board's Engineer Inspector, Mr. Arnold Taylor.

Other administrative shortcomings, referred to in the body of this report, those, for instance, in connexion with house drainage and disposal of refuse and excrement, deserve the attention of the Sanitary Authorities of "Worthing," "West Worthing," West Tarring, and Broadwater; but in the first instance and principally they should deal with the important questions of how to provide pure and sufficient water supply and efficient sewerage arrangements.

ADDENDUM A.

Showing, in parts per 100,000, the amount of Chlorine present in certain samples of Water collected from Well C. of the "Worthing" waterworks prior, as well as subsequent, to pouring a ton of salt in solution down the 1885 shaft (re-opened for this purpose in 1893).*

Sample.	Date and Hour when Sample was taken.	Chlorine parts per 100,000.
A	August 17th, at 11.30 a.m.	5·0
B	„ „ 1 p.m.	35·8
C	„ „ 3 p.m.	8·8
D	„ „ 6 p.m.	6·1
E	„ „ 9 p.m.	5·7
F	„ 18th, at 9.15 a.m.	5·0
G	„ „ 9.30 a.m.	5·0
H	„ „ 3.15 p.m.	5·0
I	„ „ 9 p.m.	5·0
K	„ 19th, at 9.30 a.m.	5·0
L	„ „ 7 p.m.	5·1

ADDENDUM B.

(*Not reproduced.*)

* The salt solution was poured down this shaft on August 17th, 1893. The process commenced at 11.30 a.m., immediately after Sample A. had been taken, and continued until 12.45 p.m., when it terminated.

ADDENDUM C.

App. A. No. 6. On Enteric Fever in Worthing, Broadwater, and West Tarring; by Dr. Theodore Thomson.

Dr. Klein's Report.

SUMMARIES of Dr. Klein's Reports on Samples of "WORTHING" and of "WEST WORTHING" Waters submitted by him in 1893 to BACTERIOSCOPIC EXAMINATION.

The following samples of water were submitted to Dr. Klein for examination:—*

A. "Worthing" water supply, taken July 26th.
B. Do. do. taken August 8th.
C. "West Worthing" water supply, taken August 21st.
D. Do. do. do. do.
E. Do. do. taken December 7th.
F. "Worthing" *temporary* supply from Broadwater, taken Nov. 29th.
G. Do. do. do. do. taken Nov. 30th.
H. Do. do. do. do. taken Dec. 7th.
I. Do. do. do. do. do. do.
K. Do. do. do. do. do. do.

Methods of Examination.

The methods of examination resorted to were as follows. With the view of ascertaining the quantity of micro-organisms per cubic centimetre of the water under investigation the ordinary method of plate cultivations was employed. This plan consists of adding to nutrient gelatine in a fluid state a small quantity of water to be examined (the amount employed varying from one c.c. to a fraction thereof), shaking the mixture so as to aid distribution of the water throughout the gelatine, and then pouring the mixture on plates. These plates, on which the gelatine mixture solidifies, are then transferred to an incubator and maintained at a temperature of 20° C.; and by subsequent observation the number and nature of the organisms that grow on the gelatine are ascertained.

Another method was resorted to in searching for particular microbes in water from a given source, and for the following reasons:—

(*a.*) The bacillus coli and the enteric fever bacillus,, when present in drinking-water, exist there for the most part in relatively small proportion. Thus, if only a small quantity of water, such as one c.c., be examined, it is likely that the organism, sparingly present in the total bulk of water, may not be present in a small sample, although present in a larger bulk.

(*b.*) If the numbers of other micro-organisms amounts to several hundreds or more per c.c.—and this is usually the case when water is unfiltered—there is risk that the numerous colonies of these may on plate cultures obscure and prevent recognition of scantily present bacillus coli or enteric fever bacillus.

(*c.*) One of the bacteria most frequently found in water is the bacillus fluorescens liquescens, which grows much more rapidly than either the bacillus coli or the enteric fever bacillus, and liquefies gelatine very quickly. Abundance of the first-named bacillus in the water under examination would accordingly, by liquefaction of the gelatine mixture, tend to prevent detection of either of the last-named bacilli. With the view, therefore, of overcoming these difficulties the following means were adopted:

* In each case a gallon of water, collected in a clean jar, was sent for examination. Prior to collection of the sample the jar was rinsed with water from the source from which the sample was about to be taken.

(1.) A considerable bulk of water (from 1,500 to 2,500 c.c.) was submitted to examination. For this purpose the quantity to be examined was passed through a sterile Berkefeld filter, which retained on its outer surface all or nearly all the particulate matter contained in the water. The matter thus retained on this outer surface was then brushed with a sterile brush into 20 c.c. of sterilised water and mixed therewith. Of this mixture 1 c.c. was added to each of a series of gelatine plates and broth* tubes. Accordingly these tubes and plates contained all or nearly all the particulate matter of the total quantity of water selected for examination.

(2.) To prevent obscuring of the bacillus coli or the bacillus of enteric fever by other organisms that grow more rapidly than they, or that soon liquefy the gelatine, a small quantity of phenol was added to the culture media. For this purpose a 5 per cent. watery solution of phenol was used, and this solution was added to the culture media in the proportion of 1 of the former to 100 of the latter. The added phenol, which does not interfere in any way with the growth and multiplication of the bacillus coli or of the bacillus of enteric fever, exerts a marked inhibitory effect on such water bacteria as bacillus fluorescens liquescens, the proteus vulgaris, and others; and, by retardation or suppression in this way of growth of these latter organisms, better opportunity is afforded of detecting in waters examined the presence of the bacillus coli or of the bacillus of enteric fever.

The gelatine-plate and broth-tube cultures thus prepared, were incubated at a temperature of 20° C. and of 37° C. respectively. From growths of the bacillus coli or the enteric fever bacillus obtained in these ways sub-cultures were made in the ordinary manner.

Features characteristic of Bacillus Coli and of the Enteric Fever Bacillus.

Bacillus Coli.	Enteric Fever Bacillus.
Shorter and less mobile than the enteric fever bacillus.	Longer and more mobile than the bacillus coli.
Forms gas bubbles in gelatine shake culture.	Does not form gas bubbles in gelatine shake culture.
Curdles milk in 1–2 days at 37° C.	Does not curdle milk.
If grown in broth for several days forms indol.	Gives no indol reaction when grown in broth.

The above tabular statement embodies the chief distinctive features of the bacillus coli and the enteric fever bacillus, derived respectively from the contents of the healthy human intestine and from the tissues of enteric fever. Other points are as follows. In gelatine stab culture and in gelatine surface cultures these bacilli are alike in general appearance save in two respects, viz.: (*a.*) that the bacillus coli grows faster than the enteric fever bacillus, and (*b.*) that in gelatine stab-culture the former organism forms on the upper surface of the gelatine a larger plate-like growth than does the latter. On gelatine plates both organisms form on the surface of the culture medium colonies which present the appearance of flat, crenated, or irregularly outlined patches, thinner at the periphery than at the centre, translucent by transmitted light, greyish by reflected light; while colonies of both organisms, growing beneath the surface and embedded in the gelatine, are rounder than surface colonies, and appear of a brownish colour by transmitted light. Neither organism liquefies gelatine. Their growth on agar and on potato affords no definitely distinctive feature; although, as a rule, the bacillus coli forms on potato a brownish growth, while the bacillus of enteric fever forms on the same medium a colourless growth.

* Beef broth: alkaline: with one per cent. peptone and one per cent. salt added.

App. A. No. 6.

On Enteric Fever in Worthing.

Dr. Klein's Report.

Reports on Waters submitted to Examination.

"*Worthing*" *Water.*

Sample A.—Taken on July 26th from well C of the "Worthing" waterworks.

Cultivations were made on four non-phenolated gelatine plates in the ordinary manner. In this way the following common water bacteria were isolated.

(*a.*) Bacillus fluorescens liquefaciens; found in all four plates.
(*b.*) Cocci, non-liquefying and liquefying; found in all four plates.
(*c.*) Bacillus mesentericus; found in three plates.
(*d.*) Proteus vulgaris; found in three plates.
(*e.*) Bacillus fluorescens putidus; found in two plates.

Cultivations in four phenolated broth tubes and six phenolated gelatine plates were made with the particulate residue of 2,500 c.c. of this water sample driven through a Berkefeld filter, and with result as follows. Six varieties of organisms were isolated, which presented the following features:—

(*a.*) All six formed gas bubbles in gelatine shake cultures.
(*b.*) Five coagulated milk rapidly; while one made the milk thick but did not produce complete coagulation.
(*c.*) Five gave the indol reaction; while one did not give this reaction.

The appearance of the colonies formed by each of these organisms on gelatine plates, their manner of growth in shake and stab cultures, and the morphological characters of the individual organisms forming these colonies were typical of bacillus-coli. At least five, accordingly, of these six organisms are to be regarded as bacillus-coli.

No enteric fever bacilli were isolated from this water.

Sample B.—Collected, on August 8th, drop by drop during a period of 12 hours from the rising main in the "Worthing" waterworks yard.* Of this water 1,500 c.c. were passed through a Berkefeld filter; and the particulate residue on the filter was distributed among several phenolated broth tubes and phenolated gelatine plates. In all these tubes and plates the bacillus-coli developed abundantly; and, in addition, a few other colonies were detected—two in one plate and one in the other plate—which, on sub-culture, presented, morphologically, as well as culturally, all the characters of the enteric fever bacillus.

"*West Worthing*" *Water.*

Sample C.—Taken on August 21st from a house-tap connected directly with a main situated in a street within the area of "West Worthing" that showed exceptional prevalence of enteric fever. In this sample search was made only for the bacillus coli and the bacillus of enteric fever. Neither of these organisms was recovered from the cultures made.

Sample D.—Collected, on August 21st, drop by drop during a period of three hours from the rising main in the "West Worthing" waterworks yard. As in the case of Sample C, search was in this instance made only for bacillus coli and the enteric fever bacillus, and here also with negative results.

Sample E.—Taken, on December 9th, from a tap in a house situated in Brunswick Road, "West Worthing." This water was found to contain 230 microbes per c.c.; and of these microbes 50 were liquefying organisms.

* The water passing along these mains is derived from all the wells, tunnels, and headings in the "Worthing" waterworks yard, and includes, accordingly, water from well C and from the new heading.

Search was made for the bacillus coli and for the bacillus of enteric fever, but with negative results.*

Worthing Temporary Supply from Broadwater Well.

Sample F.—Taken from water mains in "Worthing" on November 29th, 1893. The water in the mains was derived from the new well at Broadwater.

With the view of estimating the number of microbes per c.c. of this water, cultivations were made on four ordinary gelatine plates, $\frac{1}{10}$ c.c. of the water being used for two of these and $\frac{1}{4}$ c.c. for the remaining two. As result it was found that microbes were present to the very large amount of 50,000 per c.c. Of these microbes from 10,000 to 12,000 were liquefying organisms. In searching for bacillus coli and the bacillus of enteric fever, 1,600 c.c. of water were employed. Among the colonies appearing in cultures made from the particulate residue of this water on the Berkefeld filter, some were observed which in aspect, size, and shape, bore a distant resemblance to one or other of the bacilli sought for: but, in sub-cultures, the growths that appeared from these did not show fundamental characters by which any one of them could be identified as either bacillus coli or the bacillus of enteric fever.

Sample G.—Taken, on November 30th, from the well at Broadwater from which was obtained the Worthing temporary supply. The procedure adopted in the case of this water was the same as that employed for Sample F. As in Sample F there were about 50,000 microbes per c.c.; but of these only some 60 or 80 were liquefying organisms, a proportion much smaller than obtained in Sample F. In Sample G organisms distantly resembling bacillus coli and the enteric fever bacillus were observed; but, as in the case of Sample F, these could not on sub-culture be identified as belonging to either of the species they resembled.

Sample H.—Taken, on December 7th, from the reservoir in the town in the "Worthing" waterworks yard. The water in this reservoir was at that time derived from the new well at Broadwater.

This water was ascertained to contain 8,800 microbes per c.c.; of these microbes 150 were liquefying organisms. Several colonies were also observed which bore resemblance to either the bacillus-coli or the bacillus of enteric fever; but none of these, on further examination by sub-culture, presented features characteristic of either of the species they resembled.

Sample I.—Taken, on December 7th, from a house tap in "Worthing." The water obtained from this tap was derived from the new well at Broadwater.

The number of microbes per c.c. of this water was found to be 600; and of these microbes 10 were liquefying organisms. Search for bacillus-coli and the bacillus of enteric fever revealed the presence of two colonies bearing resemblance to colonies of these organisms. They were, it should be noted, different in appearance from those noted in Sample H as also resembling bacillus-coli or the enteric fever bacillus. The organisms composing the two colonies found in Sample *I* resembled the bacillus of enteric fever in their great motility, in their size, in their inability to form gas bubbles, in their aspect when growing on gelatine, whether in its surface or in its substance, in the slowness of their growth, and in their inability to curdle milk or to form indol; but they differed

* On January 29th, 1894, while this report was passing through the press, three samples of the Broadwater supply and one of the "West Worthing" supply were forwarded to Dr. Klein for examination. Of the three samples of the Broadwater supply one was taken from the well at Broadwater, one from the reservoir in the "Worthing" water tower, and one from a main in "Worthing." The three last-mentioned waters contained respectively, 68 microbes per c.c., 912 microbes per c.c., and 164 microbes per c.c. The "West Worthing" water contained 196 microbes per c.c. In none of these four samples was any bacillus discovered presenting the fundamental cultural characters exhibited by the bacillus coli or the bacillus of enteric fever.

Dr. Klein's Report.

from the bacillus of enteric fever in not forming threads and chains, and in not growing at all well at 37° C. Therefore these organisms could not be regarded as enteric fever bacilli.

Sample K.—Taken, on December 7th, from a house tap in "Worthing." The water obtained from this tap was derived from a new well at Broadwater.

The number of microbes per c.c. of this water was found to be 600; among which were not observed any liquefying organisms. Search for the bacillus-coli and the bacillus of enteric fever revealed, in the cultures that were made, the presence of two colonies, exactly similar in the characters they presented to the two colonies described in connexion with Sample *I.**

* On January 29th, 1894, while this report was passing through the press, three samples of the Broadwater supply and one of the "West Worthing" supply were forwarded to Dr. Klein for examination. Of the three samples of the Broadwater supply one was taken from the well at Broadwater, one from the reservoir in the "Worthing" water tower, and one from a main in "Worthing." The three last-mentioned waters contained respectively, 68 microbes per c.c., 912 microbes per c.c., and 164 microbes per c.c. The "West Worthing" water contained 196 microbes per c.c. In none of these four samples was any bacillus discovered presenting the fundamental cultural characters exhibited by the bacillus coli or the bacillus of enteric fever.

PLAN OF SEWERS; WORTHING; WEST WORTHING; WEST TARRING; BROADWATER.

Green Lines. *Boundary of Borough of Worthing.*
Yellow „ „ *Line between Worthing and West Worthing.*
Roadways.
Red Lines „ „ *Worthing Sewers.*
Blue Lines. „ „ *West Worthing Sewers.*
○ „ „ *Manhole.*
□ „ „ *Lamphole.*

Fortnight ending April 28th 1893.

MAP 3.

BROADWATER
WEST TARRING
WEST WORTHING
WORTHING
Green Line = Boundary of Borough of Worthing.
Yellow Line = Boundary Line between Worthing & West Worthing.
= Roadways.
Persons resident in Worthing, West Worthing, West Tarring, and Broadwater attacked by Enteric Fever during the fortnight.
Scale

WYMAN & SONS LTD LITH 6286.7.

Fortnight ending May 12th 1893.

MAP 4.

BROADWATER
WEST TARRING
WEST WORTHING
WORTHING
Green Line = Boundary of Borough of Worthing.
Yellow Line = Boundary Line between Worthing & West Worthing.
= Roadways.
Persons resident in Worthing, West Worthing, West Tarring, and Broadwater attacked by Enteric Fever during the fortnight.
Scale.

WYMAN & SONS LTD LITH 6286.7.93

Green Line = *Boundary of Borough of Worthing.*

Yellow Line = *Boundary Line between Worthing & West Worthing.*

——— = *Roadways.*

Persons resident in Worthing, West Worthing, West Tarring, and Broadwater attacked by Enteric Fever during the fortnight.

Scale

Weyman & Sons Ltd Lith 6286.7.94

Green Line = Boundary of Borough of Worthing.

Yellow Line = Boundary Line between Worthing & West Worthing.

——— = Roadways.

• = Persons resident in Worthing, West Worthing, West Tarring, and Broadwater attacked by Enteric Fever during the fortnight.

Scale

Wyman & Sons Ltd Lith 6286.

Fortnight ending June 23rd 1893.

MAP 7.

BROADWATER
WEST TARRING
WEST WORTHING
WORTHING
Green Line = Boundary of Borough of Worthing.
Yellow Line = Boundary Line between Worthing & West Worthing.
= Roadways.
Persons resident in Worthing, West Worthing, West Tarring, and Broadwater attacked by Enteric Fever during the fortnight.
Scale.

WYMAN & SONS LTD LITH. G286.7.94

Fortnight ending July 7th 1893.

Green Line = Boundary of Borough of Worthing.

Yellow Line = Boundary Line between Worthing & West Worthing.

——— = Roadways.

• = Persons resident in Worthing, West Worthing, West Tarring, and Broadwater attacked by Enteric Fever during the fortnight.

Scale.

Wyman & Sons Ltd Lith 6286.7.

Fortnight ending July 21st 1893.

MAP 9.

BROADWATER
WEST TARRING
WEST WORTHING
WORTHING
Green Line = Boundary of Borough of Worthing.
Yellow Line = Boundary Line between Worthing & West Worthing.
= Roadways.
Persons resident in Worthing, West Worthing, West Tarring, and Broadwater attacked by Enteric Fever during the fortnight.
Scale

Wyman & Sons Ltd Lith. 6286

Fortnight ending August 4th 1893.

MAP 10

BROADWATER
WEST TARRING
WEST WORTHING
WORTHING
Green Line = Boundary of Borough of Worthing.
Yellow Line = Boundary Line between Worthing & West Worthing.
= Roadways.
Persons resident in Worthing, West Worthing, West Tarring, and Broadwater attacked by Enteric Fever during the fortnight.
Scale

Waterlow & Sons Ltd Lith

Fortnight ending August 18th. 1893.

MAP

BROADWATER
WEST TARRING
WEST WORTHING
WORTHING
Green Line = Boundary of Borough of Worthing.
Yellow Line = Boundary Line between Worthing & West Worthing.
= Roadways.
Persons resident in Worthing, West Worthing, West Tarring, and Broadwater attacked by Enteric Fever during the fortnight.
Scale

WYMAN & SONS LTD LITH 6286-7

Fortnight ending September 1st 1893.

MAP 12

BROADWATER
WEST TARRING
WEST WORTHING
WORTHING
Green Line = Boundary of Borough of Worthing.
Yellow Line = Boundary Line between Worthing & West Worthing.
= Roadways.
Persons resident in Worthing, West Worthing, West Tarring, and Broadwater attacked by Enteric Fever during the fortnight.
Scale

Fortnight ending September 15th 1893.

MAP 13.

BROADWATER
WEST TARRING
WEST WORTHING
WORTHING
Green Line = Boundary of Borough of Worthing.
Yellow Line = Boundary Line between Worthing & West Worthing.
= Roadways.
Persons resident in Worthing, West Worthing, West Tarring, and Broadwater attacked by Enteric Fever during the fortnight.
Scale

WYMAN & SONS LTD LITH 6286.7.94

Fortnight ending September 29th 1893.

BROADWATER
WEST TARRING
WEST WORTHING
WORTHING
Green Line = Boundary of Borough of Worthing.
Yellow Line = Boundary Line between Worthing & West Worthing.
= Roadways.
Persons resident in Worthing, West Worthing, West Tarring, and Broadwater attacked by Enteric Fever during the fortnight.
Scale

WYMAN & SONS LTD LITH 1286

BROADWATER
WEST TARRING
WEST WORTHING
WORTHING
Green Line = Boundary of Borough of Worthing.
Yellow Line = Boundary Line between Worthing & West Worthing.
= Roadways.
Persons resident in Worthing, West Worthing, West Tarring, and Broadwater attacked by Enteric Fever during the fortnight.
Scale

Wyman & Sons Ltd Lith 6286.7.94

No. 7.

Report on an Outbreak of Enteric Fever at Chester-le-Street; by Dr. Maclean Wilson.

The Medical Officer of Health of Chester-le-Street Rural Sanitary District having reported a sudden outbreak of enteric fever at the village of Chester-le-Street, and having further intimated his belief that a public water service was concerned in the dissemination of the fever, this inquiry was ordered by the Board and I was instructed to make it.

Chester-le-Street is a very ancient village situated on the old post road between Durham and Newcastle, at a point where it crosses the Stanley Burn by a bridge. This stream is a tributary of the river Wear, which it joins a few hundred yards below the bridge. The oldest part of the village is on the south bank of the burn, and extends some two or three hundred yards southwards along the old post road, which here forms the main street. The newer houses lie on the confines of the village, some at the extreme south, some to the west of the main street, and others on the north bank of the burn. The village is now inhabited chiefly by coal-miners and their families, and as new pits have been opened out in the neighbourhood the population has rapidly increased from 3,350 in 1881 to 4,864 in 1891. The building of new houses has not kept pace with this increase in population, and as a consequence there is a good deal of overcrowding. It is said, indeed, that there is not a single empty house in the village, and that in several instances what were formerly single houses have now been divided into two or more tenements. The village has many of the sanitary defects of the old country hamlet as well as those of the modern pit village.

In the earlier part of 1892 two cases of enteric fever were notified (under the Act of 1889) to the Medical Officer of Health, one on the 16th April, the other on the 8th August. In each instance the patient had just come to the village, and seemingly had caught the disease elsewhere. On inquiry no connexion could be traced between these cases and those occurring later in the year.

Another case, notified on 8th October, was followed by three others in the same household; but, as will be afterwards seen, there are good reasons for attributing this family's illness to other cause than that producing the general outbreak.

From 14th November 1892 to 24th January 1893, 17 cases were notified, besides the three mentioned as following the October case. Then, after an interval of two or three weeks, came four cases on 10th February, three on 13th, three on 14th, and altogether 38 cases between 10th February and 19th March, after which there was cessation of the fever. In all, from October to Mid-March there were 43 families invaded, and there have occurred up to the date of inquiry 58 cases with four deaths.

The sufferers in this double outbreak were not persons residing in any particular part of the village, but were scattered over nearly every part of it, some in the more crowded and ancient houses in the centre, and some in the newer property at the upper end of the village and on the north bank of the stream.

The course of inquiry pursued was to trace if there was anything in common amongst the several patients which could possibly be the cause

of the fever, eliminating the cases of those who might be supposed to catch the disease from others in the same family or from their neighbours; and in doing this the various ways in which enteric fever may spread were considered under four heads:—Through personal contact with patients or their excreta, through milk (or other food), through faulty drainage arrangements, and through water supply. A table which gives details of the households invaded, with a statement of the facts ascertained under these four heads, will be found in the Addendum.

On inquiry respecting the 43 households attacked it was found that 10 might be set aside as probably infected in some other way than that through which the general outbreak arose. In the other 33 households the persons first attacked had nothing in common in their occupations of a sort to lead to their falling victims to the infection. Of these 33 persons 13 were pitmen, but they worked at four different pits, some of them underground, others on the bank. Amongst the others were school children of three different schools, housewives, a vagrant, a grocer, a clerk, a blacksmith, a moulder; in short, representatives of nearly every working class in the village. It may, therefore, safely be assumed that the occupation of the patients was not the condition which was responsible for their catching the disease, nor was there anything in the way of their social intercourse which afforded a satisfactory explanation.

The question of milk supply presented a little more difficulty. Twelve of the 33 patients under discussion procured their milk from A., whose nephew was one of those suffering from the disease in February. But on inquiry it was found that there had been little intercourse between this boy's family and that of A., that he had never been to the cowsheds or dairy, and that no one there had been ailing during the last year. On visiting A.'s cowsheds it was ascertained that they were overcrowded and badly ventilated, that the dairy or milk house was very unsuitable for its purpose, being small, ill-ventilated, and badly lighted, and opened close beside the door of a cowshed near to a small cesspool which received the drainage from the stables. But it was also found that A. supplied the milk used at a large institution in the village, where no case of fever had occurred. That so many of the sufferers were A.'s customers is easily accounted for by the fact that A.'s dairy is much the largest in the village, the milk of 24 cows being distributed from it daily. D.'s milk supply also came under some suspicion, as D. was in the habit of visiting one of the patients when he was ill; but as only two others of those attacked used D.'s milk, and as there were many other customers who did not suffer, it is not at all likely that infection was disseminated by it. There were altogether nine milk supplies patronised by these 33 patients, so it is evident that the milk did not form a common source of infection.

The sanitary defects of the dwellings might possibly be thought of as the cause of this outbreak of fever, for sanitary defects were present in the majority of the houses invaded; but the most glaring were in connexion with the 10 cases which have been set aside, and even in those instances the persons who suffered were seldom those most exposed to the evil, as will be seen from the notes to the table. Among the other 33 invasions many of the houses were in fair sanitary order, they were scattered in all parts of the village, and few or none had any direct connexion with the town sewers: so that nothing in this direction could lead one to suppose that the epidemic was due to faulty sanitary arrangements.

There remained only the water supply; and with regard to this the fact at once appeared that, with two exceptions, every household

attacked by the disease was using the same water supply, and that these two exceptions were amongst those 10 of the initial cases which were possibly not due to the cause producing the general outbreak. The history of his illness, given me by the first of these two patients without any suggestion on my part (see the notes to Case (1) in the table in the Addendum); the time of his attack, more than a month previous to that of the next patient; and the total want of connexion traceable between his illness and any other antecedent or coincident case, left no doubt in my mind but that he had been exposed to an infection which did not affect others in the community. The case of the second of these two (as will be seen from the notes to Case (12) in the table) presented features which cast doubt on the diagnosis. Many of the usual symptoms of enteric fever were in this case wanting, and those present might well have been entirely due to the illness (meningitis) which is said to have followed the attack of enteric fever; and without any disparagement of the skill and judgment of the medical man who attended the case, one may be allowed to question whether this was a case of enteric fever at all.

In every one of the other 41 households the water of the Chester-le-Street Water Company was used. But before accepting the conclusion that a contaminated water supply was the cause of the epidemic it will be necessary to ascertain:—first, what proportion of the inhabitants used it; and secondly, whether there was any way in which the infection of enteric fever germs could gain access to it.

The village is supplied almost entirely by two water companies, only a very few families having recourse to well water. The Chester-le-Street Water Company was formed over 20 years ago to procure a supply of water from the Stanley Burn. It is impossible to give exactly the number of houses supplied with this water, without a special census, as the water pipes are seldom carried into the houses, but often only into the yards, where one tap is used by many families.

The Consett Company's water was introduced into the village in 1885, and the company, to prevent waste, make it a rule that their customers must have a tap in the house without any sink or gulley under it. They can thus tell exactly how many families they supply, and the company's inspector gives the number as 445. The Medical Officer of Health reports that there are some 1,100 houses in the village, so that, neglecting the few households resorting to wells, there are some 40 per cent. supplied by the Consett Company, and some 60 per cent. by the Chester-le-Street Company.

The Chester-le-Street Company draws its supply rom the Stanley Burn, about two miles above the village. At the intake there is a weir to direct the water into the pipes, the open ends of the pipes being protected by a double wire screen to keep out leaves and other floating bodies. But at the time of my visit these screens were so arranged that the water did not require to pass through them to enter the pipes. A few yards lower down these intake pipes deliver into a settling tank about 3 feet square, and from this the water flows into the main, which is said to be covered by a rose. The main conveys the water by gravitation (with a fall of 130 feet) to a filter bed. The man in charge says that there are several valves in the course of the main through which the water can be turned into the stream again, and that these have to be opened occasionally to scour the pipes, in order to keep them clear of sand and mud. The filter bed, which is situated on some high ground close to the village and within 200 yards of the railway station,

seems to have been made when the company was first formed, and not to have been much disturbed since, except for renewal of sand in a way presently to be described; at any rate, I am told that it has not been opened out for the last 13 years. It is constructed of brick and mortar, forming a tank 24½ feet by 49½ feet, and of unknown depth. Surrounding it on three sides in the form of a horseshoe is the service reservoir, covered in, and, I am told, constructed of brickwork with a coating of cement. It is said that the filtered water enters this reservoir through holes in the walls of the filter bed. The filtering medium is said to consist of 4 or 5 feet of gravel and fine sand, with a layer of cobblestones at the bottom of the tank, but, as will be seen, the thickness of the sand varies immensely at different times. This is the method followed:—Once a year, after the clogged surface layer of sand has been removed, about 150 cartloads of fresh sand are poured in. This sand is procured from the banks of the Wear close by, having been deposited by floods, and the Weir above this point receives the untreated sewage of a large population both urban and rural. The water is turned on to the filter bed and allowed to run through it until the surface layer of sand begins to get clogged, a period which varies from ten days to three weeks, according to the state of the water. The water is then turned off and the bed allowed to dry, when the man in charge skims off about an inch of mud and sand, and delves the new surface to a depth of a foot or so. The water is again turned on, and the same process is repeated throughout the year until the sand has been in the main removed, when another 150 cartloads have to be filled in. The process of paring the surface of the filter was done in my presence, and I was told that the level of the sand was then at its lowest, as it was time for its periodic renewal. At that time the surface of the filter was 5 feet 5 inches below the level of the overflow pipe, and I was told that 3½ feet of additional sand was to be thrown in, so that the thickness of the filtering medium varies as much as 3½ feet. As has been noted above, the filter bed is surrounded on three sides by the reservoir; on the fourth side is well manured garden ground, extending up to the wall of the filter bed, and as the wall is made apparently of ordinary bricks and mortar, and is dilapidated in many places, there is no doubt but that in time of heavy rainfall the soakage from this garden gets into the filter bed. The reservoir is said to contain sufficient water to last for a fortnight if the supply is turned off at night. On the town side of the reservoir is the valve pit containing the pipe from the stream to the filter bed, as well as the distribution main from the reservoir to the town, and these two are joined together by another short main, so that the water from the burn can be turned into the town without passing through the filter bed. This, however, is said never to be done.

On examination of the Stanley Burn above the intake, numerous pollutions of the water were seen. The chief were at Alma Pit Houses and Boundary Cottages (some 40 tenements); at Craghead, where the sewage of 20 or 30 houses runs directly into the stream, and also the effluent from a small sewage farm, which receives the sewage of 70 or 80 houses; and at Southmoor where 100 houses drain directly into a tributary, and another group of 150 houses send their sewage, after very imperfect treatment by irrigation, to join the main stream. Altogether, the Medical Officer of Health estimates that the sewage of a population of 3,500 persons passes directly or indirectly into the Stanley Burn and its tributaries, above the intake of the Chester-le-Street Company, about half of this sewage being thus disposed of without any attempt at purification.

Attention was directed to the sewage of a group of cottages at Southmoor, called High Row, about three miles above the intake of the Chester-le-Street Company, by the fact that enteric fever had been recently present in some of them. These cottages form a street, 10 houses on each side, some 10 or 15 yards apart. Their sewage arrangements are very primitive. An open gutter of unglazed channelled bricks runs on each side of the street, about 6 feet from the houses, and ends in each instance in a small cesspit, covered by a grating. From these two cesspits, or rather gulleys, a covered drain leads, 20 yards off, into a small stream—a tributary of the Stanley Burn. The housewives told me that all slop-waters, including contents of chamber utensils, are emptied into these channels.

The medical man who attends the inhabitants of these cottages reports that on the 4th October 1892 a child died there of convulsions following diarrhœa, and that immediately afterwards three other persons in the same family were laid up with illness of which the chief symptoms were fever, diarrhœa, and debility; also that in January three persons in the family living next door to the formmer patients fell ill of undoubted enteric fever, these cases being followed by others amongst their neighbours. He has now no hesitation in saying that the illness in the first family in October was also enteric fever. The dates of notification of the January cases at High Row were;—

2nd January, two cases; 5th January, one case; 23rd January, two cases; 24th January, one case; 4th February, two cases; 22nd February, one case; 23rd February, one case.

There can be little doubt then that first during October, and again during January and February, the bowel discharges of enteric fever patients were passing into a stream which forms a tributary of the Stanley Burn, whence they could enter the pipe delivering to the filter-bed of the Chester-le-Street Water Company; while, from what has been said of the method of filtering in use at Chester-le-Street, and the state of the filter bed, it may fairly be assumed that there was nothing to prevent any germs of enteric fever contained in the Stanley Burn water from gaining access to the street mains of the company.

To recapitulate:—There appeared nothing in the inter-relations of the sufferers by fever, nothing in the milk supplies used by them, and nothing in their sanitary surroundings, in the least likely to afford a common source of infection. On the other hand is the fact that so many persons using the same polluted water supply suffered while their neighbours who used other water escaped. Furthermore, there occurred, shortly before each of two outbreaks of the fever, opportunity for the bowel discharges of enteric fever patients gaining access to the particular stream which afforded the water supply of invaded households in Chester-le-Street.

In concluding this report I should like to express my thanks to Dr. Duncan and the other officials of the Sanitary Authority for their assistance in this inquiry, and to the officials of both Water Companies for information courteously afforded me.

App. A. No. 7.

On Enteric Fever at Chester-[illegible]

ADDENDUM.

The following table gives the dates on which the first sufferer in each household was attacked, the age of the patient and his occupation, and the water supply and milk supply for the household

Number of House hold.	Date of Notification of First Case in Household.	Total Attacks in House-hold.	Age and Occupation of first Sufferer.	Water Supply.	Milk Supply.
*1	8th October -	4	14. Painter - -	Connett -	A. and B.
2	14th November -	1	25. Pitman - -	Chester -	C.
3	18th „ -	4	20. „ - -	„ -	C.
4	23rd „ -	1	23. „ - -	„ -	D.
5	23rd „ -	1	28. Clerk - -	„ -	D.
6	28th „ -	3	13. Schoolgirl -	„ -	D.
7	2nd December -	1	15. Pitman - -	„ -	Preserved.
8	18th „ -	1	19. „ - -	„ -	B.
9	26th „ -	1	40. Housewife -	„ -	E.
10	28th „ -	1	26. Blacksmith -	„ -	?
11	28th „ -	1	26. Pitman - -	„ -	A.
*12	9th January -	1	41. Housewife -	Consett -	?
13	24th „ -	1	17. Pitman - -	Chester -	?
14	10th February -	2	21. Housewife -	„ -	A.
15	10th „ -	2	10. Schoolboy - -	„ -	E.
*16	10th „ -	1	18. Domestic servant	„ -	A.
*17	13th „ -	1	21. Housewife -	„ -	Preserved.
*18	13th „ -	2	3. Infant - -	„ -	A.
19	13th „ -	1	24. Pitman - -	„	A.
20	14th „ -	1	23. „ - -	„ -	A.
21	14th „ -	1	6. Schoolgirl -	„ -	A.
22	14th „ -	1	30. Housewife -	„ -	F.
*23	19th „ -	1	20. Pitman - -	„ -	E.
24	20th „ -	1	10. Schoolboy -	„ -	A.
*25	20th „ -	1	19. Pitman - -	„ -	C.
26	20th „ -	1	24. Vagrant - -	„ -	?
27	21st „ -	1	18. Pitman - -	„ -	A.
28	22nd „ -	1	12. Schoolboy -	„ -	Preserved
29	23rd „ -	4	18. Pitman - -	„ -	E.
*30	24th „ -	1	12. Schoolgirl -	„ -	G.
31	25th „ -	1	10. „ -	„ -	H.
32	25th „ -	1	43. Moulder -	„ -	A.
33	25th „ -	1	18. Pitman - -	„ -	A.
34	26th „ -	1	13. Schoolboy -	„ -	B.
*35	28th „ -	1	16. Girl at home -	„ -	A. and I.
36	28th „ -	1	16. „ -	„ -	A.
37	5th March -	2	36. Pitman - -	„ -	A.
38	5th „ -	1	26. Housewife -	„ -	G.
39	5th „ -	1	8. Schoolgirl -	„ -	A.
40	7th „ -	1	27. Housewife -	„ -	Preserved.
*41	11th „ -	1	10. Schoolgirl -	„ -	?
42	14th „ -	1	23. Housewife -	„ -	B.
43	16th „ -	1	25. Grocer - -	„ -	F.

The cases marked with an asterisk are those in which there was some reason to suspect a source of infection other than that causing fever in the majority of sufferers.

(1.) This boy says that he was engaged in the beginning of September cleaning out, removing old wall paper, and repapering and painting, in a house so dirty that the smells made him sick, and that he felt ill from that time onwards. He also states that ten days afterwards he drank water from a dirty pond at Pelton Fell, and was ill and could not eat in the evening; that next day he had to return home from his work and was confined to bed in a few days, suffering from enteric fever.

(3.) Was a great friend of (2), visiting him nearly every evening; both fell ill about the same time. This patient lived in a house which had a privy-midden against the wall of a cupboard in the back kitchen where the food was kept. As the excreta of (3) were all thrown into this privy-midden it is not difficult to account for the spread of the disease to other three members of this family.

(5.) Is the son-in-law of milk-seller D., who visited him frequently during his illness.

(6.) This girl's mother is the grandmother of (21), and there was frequent intercourse between the families.

(7.) This patient's household uses the same privy-midden as (4), and the house is only 12 yards away from it; but he was the only one in the family who suffered, and other neighbours quite as near to the privy-midden and also using it were not attacked.

(9.) Lived in a house within 20 yards of a butcher's midden, into which blood and offal from the slaughter-house were constantly thrown and allowed to accumulate for weeks: but other neighbours lived much nearer the midden and were not attacked.

(12.) Is said by her medical attendant to have had enteric fever without diarrhœa and tympanites. Enteric fever was inferred from the temperature, slight pain over the bowels, and a few spots on the abdomen. Cerebral meningitis of a tubercular nature is said to have followed, and the patient at the time of my visit had well marked paralysis of one arm.

(16.) Lived in a better-class house, one of the very few which had a sink inside. The sink pipe was untrapped, and although it was cut off outside over a grating, the end was covered over by a flag so that the air from the drains could could pass easily up the pipe.

(17.) This woman's husband works for the contractor who empties the ashpits, but the husband has not been ill. She lives, as does (18), in a house which is to be closed as unfit for habitation. In the yard is a gulley, set apparently in the earth without any mortar or cement, and surrounded, at the time of my visit, by a pool of rancid slopwater. Close by is a privy-midden without a seat, a board being provided for those using the privy to perch upon. At the time of my visit the privy and the ground in its neighbourhood were covered with excrement. The gulley and the privy-midden serve for the occupants of nine tenements, and here again those who suffered from fever were not those nearest the nuisance.

(23.) Frequently visited (11) during his illness.

(24.) Is the nephew of milkseller A.

(25.) This patient's illness was preceded by a doubtful case in the same house, unattended by a medical man, and unnotified. This other person had been in the service of the owner of the property where (17) and (18) live, and was frequently employed by his master to clean the yard there and "to keep the ashpit in order." He tells me that he was doing so while (17) was ill.

(29.) There is little wonder that the disease spread in this man's house, which contained in two rooms 11 persons and six dogs. The midden-privy, which served for four tenements, is distant five or six yards, and when it is emptied the contents have to be carried through a passage past the house door.

(30.) This girl's family use a privy-midden which is common to eight houses, amongst them those of (19) and (21).

(35.) Washed for (1); and used the same privy-midden as (8), but lived at a good distance from it.

(39.) Lives in a house which has a privy-midden against the wall, and which is damp from soakage.

(41.) Lives in a house, against the wall of which is placed the privy-midden used by (19), (21), and (30). Here again there was evidence of the liquid contents of the midden soaking through the walls.

(42.) Has a stable adjoining her house and a midden of large size within four yards of her window.

(43.) Uses the same privy-midden as (22).

No. 8.

Report on an Outbreak of Enteric Fever in certain Villages situated on the River Rye in North Yorkshire; and on the Water Supply of the Malton Urban Sanitary District; by Dr. R. Bruce Low.

On December 25th, 1892, Dr. Muil, Medical Officer of Health for the Kirkbymoorside Rural Sanitary District, reported to the Local Government Board a number of cases of enteric fever as having recently occurred at the village of Nunnington. A few days later, Dr. Ernest Colby, Medical Officer of Health for the Malton Rural Sanitary District, similarly reported several cases of enteric fever in the villages of Butterwick and Brawby, which lie a few miles from Nunnington. It was further intimated that this outbreak was in all probability referable to the use, by the persons attacked, of water taken from the Rye, upon the banks of which river the above villages are situated.

In view of these and subsequent reports, and having regard to the fact that two Rural Sanitary Districts were seen to be involved in the outbreak, the Board directed that inquiry should be made by the Medical Department into the circumstances of the prevalence of fever in the above-mentioned villages.

On visiting the locality I found that the enteric fever in question had shown itself in four villages, viz., Nunnington and Ness, in the Kirkbymoorside Rural Sanitary District, and Butterwick and Brawby, in the Malton Rural Sanitary District. All four villages are situated on the banks of the River Rye, not far distant one from another, on the south side of the Vale of Pickering. This vale is an extensive strath or open valley, about eight miles wide, extending a distance of over 30 miles from the coast between Filey and Scarborough, to Helmsley, a small town situated at the base of the Hambleton Hills. The River Rye and its tributaries drain this extensive valley, the soil of which is alluvium, and the land for the most part is under cultivation. A map of the district is attached.

The following is a brief description of the villages and their sanitary circumstances.

Nunnington, in the Kirkbymoorside Rural Sanitary District, is situated on the south bank of the Rye, upon the slope of a spur of the Hambleton Range, which here runs close to the river. The village consists mainly of two parallel streets extending from the river up the slope and connected by a shorter street near the river side. The census of 1891 gives Nunnington parish a population of 354 living in 76 houses. The area of the parish is 1,987 acres, and its rateable value is 2,266*l*. Some of the cottages are dilapidated, of antiquated construction, and damp; the latter condition being largely due to absence of spouting round the eaves. Lately a

few dwellings of a more modern kind have been built. There is no proper *sewerage*; slops find their way by gutters or other channels into the highway drain at the lower part of the village, and this in turn empties itself into the river. *Excrement disposal* is by means of midden privies situated usually in gardens or backyards. Some privy pits are sunk two feet or more below the surface of the ground. Refuse disposal is by uncovered ashpits or middens connected with the privies. At the date of my visit some of these privies and ashpits were in a neglected state. The middens are emptied by some of the occupiers twice a year, in spring and autumn; other persons, however, get rid of their refuse once a year only, and occasionally even this period is exceeded. The contents of the ashpits and privies are disposed of upon gardens and allotments near the village. *The water supply* is for the most part drawn by hand from the River Rye, at a point just above the village. There are, however, four private pump wells situate in the lower part of Nunnington, not far from the river's bank. One of these pump wells is resorted to by a number of householders who have received permission to use the water. This well is 27 yards from the Rye, and its depth is only seven feet. The water in it stands 3 feet from the surface of the ground. The well is only loosely covered by flags, through which surface water can easily pass; moreover, the well is merely dry steined, the joints being uncemented. There is a large midden privy within 14 yards of this well; and about seven yards from it is a slop drain and gulley. The other private wells are somewhat similarly situated, but they are mostly used by single households. The majority of the inhabitants of Nunnington, however, drink the river water. The churchyard is situated at the higher part of the village, on the slope above it. The people are engaged in agricultural pursuits. The geological formation on which Nunnington is built is the Middle Oolite. Close to the river there is alluvium and gravel.

Ness, in the Rural Sanitary District of Kirkbymoorside, is situated on the south bank of the Rye. It is a mile or so below Nunnington, at the base of the spur of the Hambleton Range, which here abuts on the river. At the last census, Ness township had a population of 95 in 21 inhabited houses. The area of the township is 1,317 acres, and its rateable value is 1,537*l*. The sanitary condition of Ness resembles that of Nunnington. Some cottages are damp. There is no sewerage; slop water is thrown out into the road, or to the roots of bushes in the gardens. The excrement disposal is by midden privies emptied at intervals on garden land. The occupier of the house in Ness furthest up stream has drained his privy midden and cow stable into the Rye at a point about 20 yards above a spot where some of the villagers draw their drinking water from the river. Though the majority of the inhabitants drink river water, there are several wells, which are sunk in porous soil near the river. When the latter is in flood the level of the water in the wells is raised. These wells are unprotected from soakage.

Butterwick, in the Malton Rural Sanitary District, is also on the south bank of the Rye about three miles below Ness. This village is built on alluvial soil adjoining the river. At the census of 1891 the inhabitants of the township numbered 69, and the inhabited houses were 13; its area is 500 acres, and its rateable value 802*l*. There is no sewerage. Midden privies are in use as at Nunnington and Ness. Drinking water is mostly taken from the river, but some farm-houses standing back from the Rye have private pump wells.

Brawby, in the Malton Rural Sanitary District, is on the north bank of the river about half a mile below Butterwick. The village occupies a flat tract of alluvial land close by the Rye. In 1891 the population of the township numbered 148, and the inhabited houses were 33. The area of the township is 1,080 acres, and its rateable value 1,359*l*. There is no sewerage; slops are thrown into the nearest ditch, or find their way thither by roadside gutters. The ditches empty into the river. Uncovered privy middens are in general use. The water supply is partly from shallow wells, and partly from the river. The wells are dug in the porous soil close to the houses and exposed to the soakage from dung-heaps, privies, cow stables, and pigstyes. Some of these wells are covered in, others are open. Owing to the absence of sewerage, the subsoil is soaked with animal impurities, and consequently every well in Brawby is polluted, or in considerable danger of pollution. When the river is in flood the water in the wells rises. About 10 households in Brawby habitually use river water for drinking purposes. Below Brawby none of the village populations on the Rye are, so far as I could learn, in the habit of drinking the river water. Through the repeated representations of Dr. E. Colby, the Medical Officer of Health, a scheme for sewering Brawby is under consideration; plans and specifications, I understand, have been prepared to this end, and are now engaging the attention of the Sanitary Authority. As far back as last autumn Dr. Colby urged on the Brawby people the necessity for boiling all their drinking water before using it. The inhabitants of this village, like those of the others already mentioned, are engaged in agricultural pursuits.

Enteric Fever.

The recent occurrence of enteric fever in these villages seems to have commenced about the end of the first week of November 1892. During November it appears that influenza was epidemic in these riverside villages, and all cases of illness attended by feverishness and diarrhœa were attributed to this prevalent malady, and especially was this so where medical assistance had not been sought. In the course of my inquiry I ascertained that households invaded by typical enteric fever in November and December had in them at the same time cases of diarrhœa with or without observed feverish symptoms. I think it probable, therefore, that the presence of epidemic influenza in these villages masked to some extent the amount of sickness that might have been under other circumstances classed as enteric fever. In all I obtained particulars of 31 cases of illness in the four villages. Of these, 20 were recognised as typical cases of enteric fever, and two of them, both male adults, died. Five other cases were not diagnosed at the time as fever, but they suffered from headache, feverishness, and diarrhœa. Illness of this sort lasted in different individuals from two to five weeks, and was attended with considerable prostration. In six other cases diarrhœa of more or less severity was the main feature of the illness. These last-named 11 cases, which I regard as mild manifestations of enteric fever, all occurred in families already invaded by recognised enteric fever, or wherein this fever not long afterwards appeared. There are therefore grounds for regarding the whole of the 31 cases I have mentioned as all due to one and the same poison. In a tabular form I give the number of cases occurring during the months of November and December, 1892, and in January, 1893, in the four villages above-named.

TABLE I.—SHOWING cases of ENTERIC FEVER and of illness of similar sort occurring at NUNNINGTON, NESS, BUTTERWICK, and BRAWBY, during the months of NOVEMBER and DECEMBER, 1892, and JANUARY, 1893.

——	Population 1891.	1892.			1893.		Totals.
		October.	November.	December.	January.	February.	
Nunnington	354	—	4	10	7	—	21*
Ness -	95	—	—	1	1	—	2
Butterwick	69	—	—	1	—	—	1
Brawby -	148	—	5	2	—	—	7
	666	—	9	14	8†	—	31

* Two of these died.

† Six of these were secondary cases in houses already invaded in November or December.

The age and sex of the persons attacked are shown in Table II.

TABLE II.—Showing Age and Sex of ASCERTAINED ATTACKS of ENTERIC FEVER and of similar illness in Persons resident at NUNNINGTON, NESS, BUTTERWICK, and BRAWBY from NOVEMBER 1892 to JANUARY 1893.

——	Under 5.	5 to 10.	10 to 15	15 to 25.	25 to 60.	Total.
Males - -	4	2	6	3	5	20
Females - -	2	2	1	1	5	11
	6	4	7	4	10	31

The notification of infectious diseases is at present in force in the Kirkbymoorside and Malton Rural Sanitary Districts. Notification, however, had only become compulsory in the former district a few months before the outbreak. I was informed by the practitioners who attended the cases at Nunnington that they were unaware of the adoption of the Notification Act by the Kirkbymoorside Authority; no certificate forms had, they said, been supplied to them. In consequence, none of the earlier cases were notified. The outbreak only came under the notice of Dr. Muil, the Medical Officer of Health, through his being called in professionally to attend one of the fever cases at Nunnington about the middle of December.

All the cases were treated at their homes; neither of the Sanitary Authorities has provided any hospital for the isolation and treatment of such cases. At Nunnington and Ness Dr. Muil caused bills to be distributed among the householders and posted also in public places, calling attention to the urgent necessity for boiling the river water before drinking it. Disinfectant in the form of carbonic acid was supplied for mixing with the excreta. The nuisance inspector was instructed to make a house-to-house visitation at Nunnington, and to cause all accumulations of filth and other refuse to be removed from the neigh-

bourhood of dwellings. This, the inspector, apparently, had not done, for I found in Nunnington at the date of my visit instances where middens were crammed with refuse, and privies where the filth was level with the seat.

Dr. E. Colby, the Medical Officer of Health for the Malton Rural District, renewed at the commencement of the outbreak a caution given by posters and hand-bills in the previous autumn to the people of Brawby and Butterwick as to boiling all drinking water before use.

As considerable alarm was excited by the outbreak, the above advice as to boiling of drinking water was generally observed, and to this precaution the two Medical Officers of Health attributed the cessation of the epidemic.

In making inquiries as to the occurrence of previous cases of enteric fever in Nunnington and in the other villages during 1892 and in previous years, quite accidentally I ascertained that a group of at least five cases (three of them schoolboys) had occurred in Nunnington at the end of April and in May 1892. None of these cases had been reported to the Medical Officer of Health. In their earlier stages at least, the dejections of these cases had been placed in the privies of the invaded houses, and this procedure may not have been without concern in the origin of the later outbreak in November (see page 91). I could get no satisfactory explanation of the origin of this earlier group of cases.

Nunnington has aforetime born an evil reputation in regard to fever. Several outbreaks occurred on a somewhat large scale about 1872 or 1873. These the Medical Officer of Health attributed to the use of water from a pump well, situated in the lower street of the town, and fouled by soakage from adjoining filth accumulations. This well was closed by the Sanitary Authority, and no further outbreaks occurred till 1892, though from time to time sporadic cases have been met with. With the exception of the five cases in April and May 1892, and of which I heard casually (there may have been other cases at the time), there has been practically no enteric fever at Nunnington for some years. At Ness there was a small group of fever cases in 1889, but none since then till December 1892. As to Butterwick and Brawby, I could get no information as to previous outbreaks of fever in these villages.

As regards recent fever, an important point of contrast has been the different amount of it in Nunnington, Ness, Butterwick, and Brawby on the one hand, and in the rest of the Sanitary Districts in which these villages are comprised on the other hand. The four villages in question, with a total population of at most some 600 persons, had in the 12 months ending January 31st, 1893, no less than 36 fever cases or illness attributable to fever poison, whereas during the same period in the remainder of the Kirkbymoorside and Malton Rural Sanitary Districts with a combined population of between 17,000 and 18,000 persons, only 17 cases of enteric fever could be heard of; an incidence some 60 times greater on these riverside people than on the population of the remainder of the two districts.

Origin of the Recent Outbreak.

Local opinion at Nunnington at first attributed the outbreak to "atmospheric causes," later on to "the effects of epidemic influenza," and more recently the mischief was believed to have arisen from the opening up of a covered channel which conveyed slop water to the river from a group of six cottages. On investigation, however, it was found

that the interference with the so-called "drain" took place on December 3rd, after several cases of fever had occurred at Nunnington and at Brawby. What gave colour at first to this explanation of the origin of the outbreak was the fact that a man who assisted in the opening up of the slop-channel was seized with enteric fever about three weeks later and died. But this man's house had already been invaded by enteric fever about the 15th of November, nearly three weeks before the "drain" was opened. Further, the fever cases in Nunnington were scattered over the whole village. Houses on the steep slope suffered as well as those close to the river. Moreover, the Nunnington "drain" (which, by the way, was not known to carry any excrement) could have had no concern in the development of fever at Ness, Butterwick, and Brawby, except in so far as any fever poison in the "drain" might have been washed into the river, in this way polluting the water used lower down for drinking purposes.

As regards *milk supply* several of the families attacked by fever kept cows of their own, and one or two poorer patients had not taken any milk at all for months before their attack. No evidence indeed was forthcoming, at any period of the inquiry, casting any suspicion upon milk supply.

In the end it became clear that the only condition common to all the persons attacked was *water supply*, viz., water obtained for drinking purposes from the River Rye. As matter of fact it was ascertained beyond all doubt that in every house invaded by fever the water used for domestic purposes was taken from this river. On the other hand, no case of fever was met with where the water supply of the households was obtained from a private well, though many of these wells were so situated as to afford every facility for the spread of enteric fever had the specific poison been brought near enough to soak into them. And further, it may be mentioned that within a fortnight of the people of Nunnington complying with the advice of Dr. Muil to boil all water used for drinking, not a single new household there was invaded by the disease.

That the River Rye had many opportunities of becoming contaminated with the material of enteric fever will now appear.

The feeders of the Rye rise in the Cleveland Hills, and the river proper is formed by the junction of two main streams, about five miles above Helmsley. The Rye thus formed flows in a deep, well-wooded valley, part of its course being through the extensive parks of the Earl of Feversham. From these it emerges at Helmsley, where the river receives a tributary called the "Boro' Beck." The Rye then flows along the south side of the Vale of Pickering to Nunnington, having for about five or six miles elevated ground rising almost immediately from its south bank. Further on, the Rye passes through that country, and finally empties itself into the River Derwent, about four miles from the town of Malton. During the course of the Rye from its source till it reaches Nunnington it receives the drainage from a number of hamlets and scattered farm-houses along its banks, as well as from certain villages, such as Fangdale-Beck, Hawnby, and Rievaulx. Lastly it receives the sewage of the town of Helmsley, as well as the drainage of cultivated land through which it flows below Helmsley.

Specific contamination of the Rye above Nunnington by excreta from enteric fever cases may have arisen through pollution of the river derived from several separate sources; and three such sources deserve special consideration—

1. From the sewage of Helmsley, which is discharged into the river in a crude state five miles or so above Nunnington.

2. From "town manure" and night-soil from Leeds, spread upon fields near the river between Helmsley and Nunnington.
3. From privy "muck" spread by the Nunnington people, upon fields, gardens, and allotments on either side of the Rye, above the point at which they draw their drinking water.

1. The town of Helmsley, whose population in 1891 was 1,508, stands on slightly rising ground, just below the Hambleton Hills, and at the point where the Boro' Beck joins the Rye. Helmsley possesses an excellent water-supply piped from a spring at a distance from the town and thoroughly protected from any chance of pollution. The town in two thirds of its extent is sewered to two outfalls; one direct into the Boro' Beck, and the other into a tank on the banks of the Rye below the town, the overflow from this tank passing direct into the river. The remaining third part of Helmsley, which is unsewered, comprises the High Street, with Church Street and Castlegate; practically one wide, straight street, down the middle of which flows the Boro' Beck. At the top of the High Street stands the workhouse. The Boro' Beck at three different parts of its course down the street is covered over, viz., (1) just opposite and below the workhouse for a distance of 80 yards; (2) just above and opposite the church, for a distance of 141 yards; (3) at the bottom of the street to the junction of the Beck with the Rye, a distance of 120 yards. Into these archways or tunnels, the drains of houses in the High Street discharge. At the workhouse there are five waterclosets, which discharge into the first tunnel; into the second tunnel several waterclosets, one of them from a hotel, discharge; and into the third tunnel several other closets, as well as one outfall from sewers in other parts of the town, discharge. The pipes conveying sewage into these dark archways do not usually reach the water in the stream, but discharge, in many cases, on the sides of the archways. The bed of the Beck is irregular, covered with stones, and the water channel is liable to be changed by floods. These tunnels are high enough to allow boys to walk through them; and they are used by idle and mischievous persons for disposing of broken crockery, discarded pots and pans, broken baskets, disused dishcloths, worn-out matting, and other rubbish. To these in times of drought the filth and garbage cling; consequently collections of decomposing sewage mixed with human excrement accumulate, banked up within the dark recesses of these three culverted portions of the stream. At times bad smells are perceived to issue from these places, and the only way the nuisance is removed is by floods. After heavy rainfall the Boro' Beck rises rapidly, and its bed is scoured out by the storm water, the filth accumulations being swept away into the Rye. On the north bank of the Rye there are some cottages at Helmsley which have privies with movable receptacles, and the filth from these, I am informed, is from time to time emptied directly into the Rye. Altogether about 35 waterclosets are in use at Helmsley. The majority of houses, however, have garden privies, with covered ashpits attached. These privies are emptied on garden and cultivated land in and near Helmsley, which drains towards the river. There can be no question that the Rye is largely polluted by Helmsley sewage.

I inquired into the occurrence of enteric fever cases at Helmsley, or near to it. The Infectious Disease (Notification) Act has, unfortunately, not been adopted by the Helmsley Rural Sanitary Authority. But through the kindness of the resident practitioners there, Drs. Porter and Reid, I was able to obtain information of all known cases

Ante, A. No. 8.

On Enteric Fever [illegible] and other Water [illegible] Measures of [illegible] Law.

of fever during the last two years. This list comprises only four cases, viz.:—

(*a*) In March, 1891, a lad, aged 14, came home from Stockton ill with fever. His stools were at first placed in the privy, but later on they were buried in the garden. The contents of this privy were led away to cultivated land a mile from Helmsley, about the end of April (1891) following. Slop water from this house, with washings from soiled linen, would discharge into one of the archways of the Boro' Beck.

(*b.*) In January, 1892, a boy, aged 12, resident in the town, and who had not been from home for months, took enteric fever. The source of infection was never discovered. His bowel discharges were at first put into the garden privy, but afterwards they were buried. Slops and washings of soiled linen from this household would be discharged into one of the archways of the Boro' Beck. The privy contents here were not emptied and conveyed away till December 27th, 1892.

(*c.*) In May, 1892, a girl, aged 15, came home ill from Darlington with fever. Her excreta were at first passed into the privy. Later on they were buried. The privy had not been cleaned out since her illness up to the date of my visit (*i.e.*, up to February 24, 1893). Slop water and washings from her soiled linen would finally discharge into the tank, the overflow of which goes into the river.

(*d.*) In December, 1892, a schoolboy, aged 11, took ill with enteric fever. He had not been from home. His dejections at first were put into the garden privy, but later on they were buried. Slop water from this house would discharge into one of the archways of the Boro' Beck.

So far as is known these are all the fever cases that have occurred in the Helmsley district for the last two years. None were heard of in the villages or hamlets along the course of the Rye above Helmsley.

It is worthy of note that an outbreak of enteric fever, comprising 24 cases, occurred at Helmsley in 1880–81. Nearly all the cases were in the High Street along the course of the Boro' Beck. At that time it was believed that the Boro' Beck and its archways had become contaminated by the specific fever discharges from a tramp at the workhouse, the five water closets of which empty into the first archway. As bearing upon this belief the following incident which then occurred is of interest. Four schoolboys living in different parts of the town, in a spirit of bravado, dared each other to explore the dark recesses of the first archway of the Boro' Beck. All four boys did penetrate its filthy recesses, and in about a fortnight or three weeks all four boys developed enteric fever. Later on two inmates of the workhouse who had not been outside for months took the fever also. In this connexion it may be mentioned that the boy aged 11, case (*d*) above, attacked by enteric fever in December 1892 at Helmsley, admitted to me that some three weeks, or less, before he was taken ill, he had explored the dark and filthy tunnel into which the workhouse drains empty. Careful inquiry failed to indicate any other probable origin of his illness. Inquiry as to fever in 1892 at the Helmsley Workhouse proved negative. No cases of recognised fever had occurred there since the two cases just mentioned, 12 years before. From the Master of the workhouse I learned that during the last quarter of 1892 no fewer than 740 tramps had sheltered there. Among such numbers of tramps passing through Helmsley it is possible a convalescent or a mild ambulant case of enteric fever might have been included, whose bowel discharges would be capable of infecting the workhouse drains, and through them the arch-

ways of the Boro' Beck. The following Table III. shows the number of tramps sheltered at Helmsley Workhouse during the last three months of 1892:—

Tramps.	October.	November.	December.	Total.
Men - -	219	220	175	614
Women - -	38	28	19	85
Children - -	19	12	10	41
Total -	276	260	204	740

No cases of illness resembling enteric fever were observed among any of the tramps included in the table.

I learned, however, that a girl, aged 22, who was a temporary inmate of Helmsley Workhouse from December 16, 1892, to January 18th, 1893, was taken ill with enteric fever at Slingsby (10 miles from Helmsley) on February 12th. She died on February 21st. The dates are not incompatible with the supposition that she might have received her infection while at Helmsley. But on the other hand I was informed by Dr. Sprent, of Slingsby, who kindly made some inquiry into the case for me, that the girl paid a visit to Nunnington one day between January 26th and 28th. But it was not ascertained whether she visited any fever-invaded house there or drank any of the river water. It is possible that she may have got her fatal illness at Nunnington.

At Helmsley, which is the centre for a wide but thinly populated district, there are annual fairs which bring a number of strangers from a distance to the town. One of these fairs is held in October. There is also a statute hiring for agricultural servants during November. To these fairs and "hirings" strolling players, showmen, hawkers, gipsy folk, and other low-class strangers flock. These persons usually remain in the town for a night or two.

(2.) The manuring of grass and other fields with Leeds town manure is practised occasionally in the Helmsley district. The more of human excrement this manure contains the more highly it is regarded by the farmers. On land between Hemisley and Nunnington 56 tons of this town manure from Leeds were spread in 1891 (in April and in August). The slope of this land is sharply towards the river which is less than a quarter of a mile distant. During 1892 I could hear of none being used, except that in May of that year a quantity of about six tons was received by a Nunnington farmer, who spread it on a field "up stream" above Nunnington, the drainage of this field being towards the river. In the Helmsley district I heard of one farmer who had got eight tons of this night-soil manure in February 1892, and this was taken to land a mile from Helmsley; the drainage of this land, which is on a steep slope, would readily reach a rivulet which enters the Rye below Helmsley.

This night-soil, stored in heaps or mixed with ordinary farmyard manure, might retain its power for evil for some months after its arrival; at any rate it is likely that washings from such manure would after a heavy rainfall reach the Rye and pollute it.

Enteric fever I am informed is more or less endemic at Leeds. A number of deaths are recorded from this disease there every year.

Table IV. shows deaths from enteric fever in Leeds from 1882 to 1892 inclusive:—

——	1882	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.	1892.
Enteric fever deaths in Leeds.	149	123	145	74	99	103	53	129	112	73	64

I learn that during 1890, though notification was not in force, 205 cases of enteric fever were investigated by the officials of the Health Department at Leeds; during 1891, 221 cases, and during 1892, 189 cases.

3. The manuring by the people of Nunnington themselves of gardens, allotments, and fields with privy contents, may have polluted the river with the specific poison of enteric fever. In a previous part of this report I mentioned that a group of at least five cases of fever occurred at Nunnington in April and May 1892. The stools of the patients at the commencement of the illness, if not later, were disposed of in the privies. It is the custom here to clean out some at least of these privy middens in the autumn and early winter; the "muck," as it is termed, being spread upon land. The allotments of the Nunnington people, and most of the land cultivated by the farmers of the village, lie "up stream," and more or less adjoining the river. On one side of the river at least the slope of the land is highly favourable for the washing of manure in wet seasons from the land to the river.

The River Rye then is liable to specific pollution not only by means of the sewage of Helmsley, but also through the manuring of fields and gardens with excrement from local privies. Similarly it is liable to contamination by the night soil brought by rail from Leeds, and spread on land bordering the river.

It remains to note conditions under which enteric fever poison, whether contained in filth accumulations in water-courses tributary to the Rye or pent up in manure deposited on land in the neighbourhood of that river, could become conveyed into the stream, in ways to account for both the sudden outbreak in November of enteric fever in the riverside villages, and the renewal of the disease in them from time to time during December and January.

Through the kindness of Mr. E. K. Spiegelhalter, of Malton, F.R. Met. Soc., I was able to obtain the meteorological data for the year 1892 and particularly for the last quarter of the year (see Addendum). It appears that the month of October was exceedingly wet, no less a quantity than 5·61 inches of rain being measured during that month. Of this total amount, 2·88 inches fell within 41 hours (from October 13th to 15th), 1·80 inches of it falling on the 14th. The result of this sudden and heavy rainfall was that all the streams in the district were flooded, and the low country was in places laid under water.

No doubt a large amount of filth from a wide area then at once found its way into the Rye, at the same time that similar filth became deposited as mud and slime on the submerged alluvial flats bordering the river, especially in places where the current did not run strongly or where the water was practically stationary. This deposit of mud and slime would gradually by subsequent rains be also washed into the river, re-polluting it from time to time till all was washed away.

It is probable that there was actual relation in some such fashion as that above indicated, between the flood in the Rye Valley during October, and subsequent enteric fever prevalence in villages on the river. But however this may have been, it is evident from the facts I have recorded that the Rye should no longer be used as a water-supply by the inhabitants of villages below Helmsley.

The Rural Sanitary Authorities of Kirkbymoorside and Malton should therefore take immediate steps to secure for the villages concerned, and situated in their respective districts, proper supplies of pure water for drinking purposes. Further, the Rural Sanitary Authority of Helmsley should no longer delay dealing with all the sewage of the town in a way to prevent the pollution of the river. A scheme for sewering the High Street of Helmsley and dealing safely with all the sewer outfalls upon land below the town was prepared some 12 years ago. It is very desirable that a scheme to this end should be carried into effect without delay.

Malton Urban Sanitary District.

During my inquiry in the valley of the Rye I received information from local sources that at times the town of Malton had suffered from outbreaks of illness, due, it was alleged, to pollution of the public water supply. And further, I ascertained that the source whence Malton derives its supply is situated close to the western bank of the Derwent at a point four miles below the junction of the Rye with that river. Pollution of the Rye it was seen would readily affect the Derwent also, and accordingly I was instructed to visit Malton with reference to the present condition of the water supply there. For this purpose I visited Malton on March 4th, 1893.

The Malton Urban Sanitary District, which comprises an area of 4,130 acres, had at the census of 1891 a population of 4,910. It lies on the west bank of the Derwent, which divides Malton from Norton (population, 3,633). Till lately Norton formed a part of the Malton Urban Sanitary District, and had the same water-supply; but Norton, having become a separate Urban Authority, has recently obtained a new supply, and the works are now almost completed. This new supply is situated at some distance from the river, and is well protected from pollution.

Geologically, Malton is on the Middle Oolite. The town is built on a slope which rises from the river bank, and it is provided with sewerage, the outfall of which goes direct into the Derwent. The water-supply is obtained from the "Lady Well," situated at the East end of the town on low ground, adjoining the river. The well is excavated to a depth of about 14 feet in the rock, and an abundant supply of water is constantly passing into the well from springs discharging through its sides. From the well the water is drawn through a suction pipe about 280 yards long to the neighbourhood of the town gasworks, where is situated a pumping engine which forces the water into the public mains, and into a reservoir on "the Mount," the highest part of the ridge overlooking Malton and about a mile from the pumping station.

The top of the well is very little above the level of the Derwent, from which it is distant 196 feet. Between the river and the town well are a series of pools known as the "Lady Springs," from which a large amount of water flows away. These pools are surrounded by a small embankment, in which is a sluice, through which the pool water escapes into a channel, "the cut," made parallel to the river and close to its bank. "The cut" finally discharges into the Derwent lower down.

The banks of "the cut," and also the embankment round the pools, are riddled with the holes of water rats. Fish of various kinds are found in the Lady Spring pools. There appear to be channels of communication between the pools and the Lady Well, for along with other evidence is the fact that young pike and an occasional burbot have been found in the town well.

When the Derwent is in flood it rises rapidly in the neighbourhood of Malton, and commonly overflows its banks. This flooding of the low-lying land near the river is facilitated by the damming-up of the water, by the railway embankments, and other local circumstances. In ordinary floods the overflow of the river reaches "the cut," and thence it gets to the pools, the water in which becomes discoloured. When the flood water rises beyond a certain level, the water in the town's well also becomes thick and discoloured, usually through its connexions with the pools; but occasionally flood water has been known to rise to the level of the top of the well, which then becomes directly polluted by the flood water from the river flowing into it. The present public supply has been in use for about 25 years.

In looking over the death records of Malton during the last 20 years one is struck by the circumstance that enteric fever and also diarrhœa have persistently recurred in the town. The records at my disposal date back to 1873, when it seems there was prevalence of enteric fever in the place. This prevalence continued, associated at times with outbreaks of diarrhœa, during 1874, 1875, 1876, and 1877. In 1878 there was a very severe epidemic of enteric fever in the Malton Urban Sanitary District, which at that time included Norton (the combined population being 8,168). No fewer than 315 cases were recorded up to September 30th of that year, *i.e.*, during a period of only nine months. This outbreak, it is fair to mention, was locally attributed to defects in drainage, and these were then to some extent remedied. Fatal enteric fever, as also fatal diarrhœa, are to be found in the death records of 1879, 1880, and 1881. In 1884, 1885, 1886, 1887, 1888, and 1889 enteric fever recurred yearly in the Malton Urban District; and in 1889 there was a remarkable outbreak of epidemic diarrhœa, which seems to have affected almost every household in the town. As an example of its abundance and gravity one medical man stated that he was called upon to treat 90 cases of diarrhœa in one day. Other practitioners, while not giving numbers, say that the outbreak was almost universal in the urban district at that time, viz., in October 1889. In the autumn of 1890 there was again an outburst of the same kind, though of a milder character. Public attention meanwhile had been drawn to the fact that outbreaks of fever and diarrhœa had followed seasons of floods in the river, and had been associated with the supply to the town of muddy water from the mains. Some of the residents made representations to the Urban Sanitary Authority, directly by deputation and through the columns of local newspapers, calling especial attention to the muddiness of the water, which was alleged at times "to stink," and contained, as it was said, "the sewage of all the towns and villages situated near the Rye and its numerous tributaries."

During 1892 there were no deaths from enteric fever in Malton, but 12 non-fatal cases were notified to Mr. Holt, the present Medical Officer of Health. Nearly all of these occurred before October. The diminution in the prevalence of fever, and the cessation, for the present, of outbreaks of diarrhœa may be due, in part, to the action of Mr. R. Richardson, the present borough surveyor, who was appointed about two years ago. This officer tells me that as soon as the flood water reaches a certain level, *i.e.*, before any actual discoloration takes place

in the town well, he ceases to pump water from the well to the reservoir, and pumping is not resumed till all discoloration of the water has disappeared for some time from the well water. Meanwhile the supply to the inhabitants is necessarily limited, the water being turned on from the reservoir for short periods twice daily. He says that in this way by care six days' supply can be given from the reservoir. It will be noted that the security of the inhabitants of Malton against delivery to them of polluted water rests upon the vigilance of the borough surveyor. Should he, for any reason, permit the pumping to be continued after the polluted river water has begun to gain access to the well, or should he resume the pumping process a trifle too soon before the storm water or its sediment has been washed out of the well by the continuous current of spring water passing through it, delivery of polluted water to Malton must needs take place. And under such circumstances should, by any chance, excremental matters from cholera or enteric fever cases be amongst the impurities contained in the water, the result might be disastrous to the town.

After the representations made to the Local Board of Health in 1889 skilled assistance was called in to examine the town's water-supply and and to report upon it. Messrs. Fairbank, C.E., of Driffield and Westminster, made the investigation. In their report dated April 28th, 1890, they condemned the present supply of Malton as liable to pollution, believing that river water gained access to the Lady Well by underground connexions between the river and the well, as also by the overflow of the river into the pools. They examined various suggested new sources of supply, and finally prepared plans for a new supply from springs chiefly arising in Settrington Dale, about five miles from Malton. A new reservoir was to be constructed, as the present one leaked and was also insufficient in size to supply both Malton and Norton (then part of the borough). The scheme, however, was never proceeded with, and Norton, as has been stated, as soon as it became an independent Urban District adopted a water scheme of its own.

Beyond raising a little the height of the embankment round the pools nothing, I understand, was done to secure the Malton supply against pollution.

Mr. Channon, architect of Malton, who has bestowed much time and pains in making observations on the Lady Well and its surroundings, and who kindly supplied me with sketches and gaugings he had from time to time made at flood periods, asserts that the contamination of the well always comes by way of the adjoining pools and not by any underground channels; and he is satisfied that a further heightening and enlarging of the present embankments round the pools would prevent future pollution of the town's supply.

During my visit I saw copies of analyses of the town water, all reporting favourably upon it. But these samples were not taken at the times when the well was flooded by the river. The pollution of course is only intermittent; it is especially liable to occur any time after thunderstorms or prolonged rains, or in times of rapid thaw. The members of the Malton Urban Sanitary Authority should therefore without delay reconsider the question of obtaining for the town a sufficient and uniformly wholesome water-supply.

ADDENDUM.

SUMMARY of RAINFALL for 1892, at Norton, Malton, taken by E. K. Spiegelhalter, Esq., F.R.M.S.

Rain Gauge { Diameter of funnel, 5 inches. Height of Top { Above ground, 1 foot. Above sea-level, 66 feet.

Month.	Total Depth.	Greatest Fall, 24 hours.		Number of Days in which ·01 or more fell.
	Inches.	Depth.	Date.	
January - -	1·41	·46	11th	11
February - -	1·90	·50	20th	18
March - -	·96	·25	12th	13
April - - -	1·76	·92	27th	13
May - - -	3·60	1·20	27th	21
June - - -	4·45	1·52	28th	18
July - - -	1·41	·87	19th	9
August - - -	2·64	·81	29th	16
September - -	1·54	·40	29th	12
October - - -	5·61	1·80	14th	26
November - -	1·63	·39	4th	16
December - -	1·26	·51	9th	11
Total - -	28·17	—	—	184

MAP OF RYEDALE,
SHEWING THE COURSE OF THE
RIVER RYE,
AND ITS TRIBUTARIES THROUGH THE
VALE OF PICKERING
AND SHEWING POSITION OF THE
VILLAGES ATTACKED BY
ENTERIC FEVER
DURING THE RECENT OUTBREAK.
Scale, One Inch to a Mile.
HELMSLEY
Station
The Acres
Harome
Riccal Moor
Sproxton
Salton
Normanby
Low Bottoms
Kirkby Misperton
Great Burugh
Little Burugh
Pickering
Nunnington
Oswaldkirk
Caulkleys Bank
Stonegrave
STONEGRAVE
Brawby
Butterwick
Low Moors
Hovingham
Slingsby
SLINGSBY
BARTON-le-STREET
Barton-le-Street
Appleton-le-Street
Swinton
Swinton Field
Old Malton
NEW MALTON
Great Habton
Little Habton
Barton Moor
Slingsby Carr
Slingsby Moor
Ampleforth Moor
Sprayle Howl
Earthorpe Farm
Coneysthorpe
Norton
Thirsk and Malton Branch Railway
York and Newcastle Railway
North Eastern Railway

No. 9.

REPORT on the CIRCUMSTANCES of the RIVER TRENT in Lincolnshire and Part of Nottinghamshire, with special reference to the WATER SUPPLIES of POPULATIONS resident on or near the banks of the River, and to the Occurrence amongst those POPULATIONS of ENTERIC FEVER; by DR. R. BRUCE LOW.

I.

GENERAL REPORT.

General Report.

The Trent, the third longest river in England, rises in Biddulph Moor, on the northern borders of Staffordshire. It flows through five counties, Stafford, Derby, Leicester, Nottingham, and Lincoln, a distance of about 154 miles, receiving during its course 12 large tributaries,* before it finally, on the borders of Yorkshire, joins the Ouse to form the Humber. The Trent supplies the natural drainage of a large area, estimated at 4,000 square miles, and upon the river itself or its tributaries stand many large towns, *e.g.*, Nottingham, Derby, and Leicester, besides numerous smaller towns and thickly populated districts, as well as rural villages.

The Trent for a distance of about 30 miles from its mouth (*i.e.*, from about eight miles above Gainsborough to the Humber) is a tidal river. In its tidal reaches the river is swept at spring tides by a bore, locally known as "the Eygre;" the inflowing water rises to a considerable height and advancing like a wall, rushes, with a loud noise, swiftly up the bed of the river, sweeping all before it that has not been properly secured, and scouring up the mud in the channel and on the banks, increasing in this way the usual turbidity of the water.†

At Gainsborough the water at spring tides rises from 10 to 12 feet, and is stated to flow here for three hours and to ebb for nine in every 12 hours.

The Trent is navigable for ships and steamers as high as Gainsborough and for river tugs and large barges up to Newark. Some decked barges trade regularly between Hull and Nottingham. Smaller craft go higher up the river. Sometimes cargoes of linseed or grain are brought in ships direct from Russian ports to Gainsborough, but such cargoes are more usually transhipped at Hull into river boats. A passenger steamer plies daily between Hull and Gainsborough.

The Trent has communication with many inland towns by means of canals. In the lower part of its course three enter it, viz., the Keadby Canal connecting the Trent with Doncaster and Sheffield and other places; the Chesterfield Canal connecting that town and other places with the Trent at West Stockwith; and, at Torksey, the Foss Dyke, an artificial waterway, connecting the Trent with Lincoln. Higher up

* The chief tributaries of the Trent are the Sow, Blythe, Tame, Meas, Dove, Derwent, Soar, Lene, Dover, Greet, Devon, and the Idle. There are also numerous smaller tributaries, and in the lower part of its course the Trent receives a large quantity of water from the "dykes" by means of which the flat country in South Yorkshire and North Lincolnshire was reclaimed from swamps and marshes.

† Advantage is taken of this extreme turbidity of the Trent water by utilising it to "warp" low-lying land which at high tide is below the level of the river. By cutting channels or "warping drains," which are sometimes some miles in length, the thick tidal water is conveyed to the land which is to be treated, and which has been previously surrounded by an embankment. The water before running back into the river with the falling tide deposits some of its suspended matter; as much as $\frac{1}{10}$ of an inch, it is stated, being left after each tide. It is possible in this way, in the course of two or three years, to deposit a rich alluvial soil on land which was ormerly poor and unproductive. Warp land is well known for its fertility.

the river are other canals, affording access for barges to Birmingham and other Midland towns.

Almost from its source the Trent becomes polluted with sewage. The river and several of its tributaries constitute the natural drainage of nearly the whole of Staffordshire. In its passage through the densely populated pottery district the Trent is admittedly polluted, and lower down the crude sewage of many places, and as well the effluents from sewage farms, mingle with the waters of the Trent and its tributaries. Taking two tributaries as samples of the others, the Tame, which receives sewage from Birmingham more especially at times of heavy rainfall and from the Black Country, is highly polluted; and lower down, the Derwent, which flows through the centre of Derbyshire to the Trent, receives the crude sewage of such places as Bakewell, Matlock Bridge, Matlock Bath, Belper, Derby, Alvaston and Boulton, having a combined population of nearly 120,000. The sewage of Nottingham is disposed of upon land adjoining the Trent at Burton Joyce, about five miles from the town and about 18 miles above Newark. The effluent, owing to the care which has been, and is being, taken with the preparation of the land used as a sewage farm, is, under ordinary circumstances, clear and free from objectionable smell. But in times of heavy rainfall it is found necessary to turn the contents of the flooded sewers of Nottingham direct into the Trent. In this and other ways much untreated sewage at times reaches the river. Still lower down the crude sewage of Newark passes directly into the Trent, and further down still the town of Gainsborough discharges its sewage into the river. In addition to the towns last mentioned, the whole of the intervening places on the river drain into the Trent without any attempt at purification of their sewage.

Into the lower section of the river, with which this report is more especially concerned, there is drained a considerable area of heavily manured land; so that after heavy rains the river is contaminated by the washing into it of more or less towns' manure and night soil, imported from large urban districts. The town of Nottingham, for example, where the pail system is still in use, has to dispose of more than a thousand tons of night soil every week. Much of it is taken by boats to neighbouring districts, the natural drainage of which is to the river. Such manure would be liable at any time to contain the bowel discharges of enteric fever patients, and of persons suffering from diarrhœa.

As bearing on this point I give in the subjoined tables the recorded cases and deaths from enteric fever and diarrhœa in Nottingham for some years back. The figures are taken from the annual reports of Dr. Boobbyer, the present Medical Officer of Health, and from those of his predecessor.

TABLE I.—Showing notified* Cases of ENTERIC FEVER, and Deaths thereform, in the Borough of Nottingham, from 1884 to 1892 inclusive. Population (in 1891,) 211,984.

Enteric Fever.	1884.	1885.	1886	1887.	1888.	1889.	1890.	1891.	1892.
Cases - -	218	326	317	411	426	395	348	396	200
Deaths -	68	61	74	89	87	66	58	70	32

* Notification came into force in June 1883.

Table II.—Showing Deaths from Diarrhœa in Nottingham from 1884 to 1892.

——	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.	1892.
Deaths from diarrhœa.	377	163	328	315	157	263	185	180	158

In recent years consignments of towns' manure to parts of Lincolnshire and Nottinghamshire adjoining the Trent have been on the increase; for owing to the long continued agricultural depression some farmers have been abandoning the use of costly artificial manures, and have been using instead the less expensive towns' manure.

From the towns of Huddersfield and Sheffield large quantities of night soil are brought by rail into the Gainsborough rural district, where it is spread, or stored upon land, the drainage of which is necessarily towards the river. With regard to the liability of this night soil to contain the specific bowel discharges of enteric fever, I have ascertained through the courtesy of Dr. Harvey Littlejohn, the Medical Officer of Health for Sheffield, the amount of enteric fever that has been recorded in that city during recent years.

Table III.—Showing Number of Cases and Deaths from Enteric Fever in the Borough of Sheffield during the last 5½ years, January 1st, 1888, to June 24th, 1893. (The Population in 1891 was 324,323.)

Enteric Fever.	1888.	1889.	1890.	1891.	1892.	To June 24, 1893.
Cases - - -	*	*	374	354	197	78
Deaths - - -	49	64	62	73	41	23

* Notification not in force.

There are, therefore, grounds for believing that the specific poison of enteric fever may be brought into the catchment area of the River Trent from Sheffield, along with the night soil manure which is spread upon land. Sheffield is a town where privy-middens exist in considerable numbers.

Night soil is also brought by barges from Lincoln through the Foss Dyke at Torksey into the neighbourhood of the Trent. Some of this manure is unloaded on the banks of the Foss Dyke itself, while some of it is unloaded on the banks of the Trent. A further portion finds its way by Stockwith Lock into Misterton parish through the canal there. As to the possibility of Lincoln night soil containing the specific poison of enteric fever, I have obtained, through the kindness of Dr. Harrison, the Medical Officer of Health, information as to the amount of fatal enteric fever in that city for some years back. Notification is not in force, so that only the record of fatal cases can be given.

App. A. No. 9.

On the River Trent in Lincs. and Notts., with Water Supply and Enteric Fever; by Dr. Bruce Low.

General Report.

TABLE IV.—Showing Deaths from ENTERIC FEVER in the City of Lincoln, population (in 1891), 41,491, from 1882 to June 24th, 1893.

Enteric Fever.	1882.	1883.	1884.	1885.	1886.	1887	1888.	1889.	1890.	1891.	1892.	To June 24, 1893.
Deaths	12	8	7	10	6	5	11	11	7	2	6	10

There are in the City of Lincoln 2,975 privy vaults and 950 pail closets. Though the amount of non-fatal enteric fever in the place is not known, the deaths recorded in the above table suffice to indicate that night soil collected in Lincoln may likely enough contain from time to time excrement passed by enteric fever patients. If it be urged that the bowel discharges of all reported fever patients are always thoroughly disinfected in most towns, and often kept apart from the privy or closet; on the other hand, it must be remembered that in the earlier stages of the disease the diagnosis is difficult, and diarrhœal dejections of all kinds, at first at least, get mixed with the other contents of privy vault or pail.

Towns' manure from Hull is also sometimes sent up the Trent for disposal on agricultural land. A considerable amount of what is called "stable" manure is likewise brought up the Trent in barges from Hull and delivered to farmers on the banks of the Trent. Night soil, too, comes into the Trent *viâ* the Keadby Canal. In the process of unloading barges carrying night soil manure, filth is spilt on the boat and on the banks of the river as well as into the water; after unloading, the filthy fluid remaining in the barge is pumped out into the river. But the amount of night soil brought by canal boats of late years has greatly diminished, the most of it now being conveyed by rail.

The town of Newark-on-Trent has some 1,400 pail-closets, which are emptied weekly by a contractor, and their contents removed to a depôt outside the town, to be sold to farmers in the neighbourhood as manure. At Newark there are also about 1,244 waterclosets. These discharge their contents into the Trent, and as enteric fever has been very prevalent in the town for at least four years (*see* Special Report on Enteric Fever in Newark at page 125), a considerable amount of the specific poison of this disease must have reached the river from this source as well as by way of the infected night soil manure. Newark is about 20 miles above Gainsborough. Between these two towns there are a number of villages situated on the river's banks, and these also drain into the Trent. It is a matter of common knowledge that boatmen engaged in barges, or craft of any kind in the river, throw all their urine and fæces direct into the Trent; and excrement can be seen at times floating in the water. A medical man informed me of an instance where an enthusiastic admirer of Trent water, in a riverside village, was led to abate his enthusiasm after drawing a pailful of water from the river to fill his teakettle; on this occasion he found solid fæces in the pail, and he has since discontinued the use of river water in his household. I am told that about 56 boats trade regularly from Hull to Nottingham; the dejecta of the crews of these and other boats which trade to Gainsborough will help to swell the excremental pollution of the Trent.

The town of Gainsborough, whose population in 1891 numbered 14,372, discharges its crude sewage direct into the Trent by eight

outfalls. The number of waterclosets in this town is on the increase, and the direct excremental pollution of the Trent from this source, only a few miles above certain villages which draw their drinking water from the river, is, to a corresponding extent, augmented also. Hitherto, for the artisan population at Gainsborough, midden privies, mostly of the old objectionable kind, have been in use; but in connexion with houses recently erected, trough closets and other forms of waterclosets have been provided. The contents of the midden privies, as in the other towns already mentioned, are sold for manure to farmers and others in the neighbourhood. With regard to the possibility of the Gainsborough sewage and night soil being specifically contaminated with the poison of enteric fever I have been unable, for various reasons, to obtain much definite information. Owing to the circumstances under which the Medical Officer of Health for the Gainsborough Urban District is appointed, no copies of his annual reports are sent to the Local Government Board, and consequently I could obtain no record of any past epidemics of fever in the town. From resident medical men, and from other persons, I gathered that cases fatal and non-fatal of enteric fever have occurred in Gainsborough, more or less, every year, and that there were 11 fatal cases in 1891. I also learned that during 1892 the district nurses had on their books, mostly during the autumn months, and among the poorer classes in Gainsborough, at least 23 enteric fever cases, as well as other milder cases of a suspicious nature. There were also some cases in the early part of 1893. From these facts it would seem that the town of Gainsborough has added its share of specific pollution to the water of the River Trent.

Below Gainsborough the Trent receives the sewage of some large villages, *e.g.*, Morton, Stockwith, and Owston, situated on its banks. At West Stockwith, and also at East Stockwith, are chemical works, where artificial manures and other products are prepared. The waste water from these works escapes into the river above the villages of East and West Stockwith. At the date of my visit the works were not in full operation, but I saw some dark brown fluid discharging into the river. However harmless the effluent may have been, yet the presence of chemical waste from trade processes in a drinking water is not, to say the least, desirable.

At West Stockwith the River Idle joins the Trent. Into the Idle the untreated sewage of the Borough of East Retford passes some 18 miles higher up. The Idle is further polluted by the drainage of a large tract of land, highly cultivated and heavily manured, between Retford and West Stockwith. As regards the Idle, and the large dykes or drains entering the Trent hereabouts, it is customary in summer time, when cutting down the rank growth of weeds growing on the banks, to throw them into the water as the quickest and easiest way of disposing of them. When these collections of weeds enter the Trent they are carried up and down the river by the tide, and as other impurities (occasionally a dead dog or cat) get attached to them, the smell from these collections becomes very offensive, especially in hot weather and when the amount of water in the river is low. Those who live in villages lower down, below Stockwith, complain very much of the nuisance arising from these collections of floating weeds and dirt. One farmer went so far as to say that at times the Trent actually stank from this cause.

In the addendum to my report on the water supplies of the Gainsborough Rural District will be found copies of reports* on some analyses

* Not here reproduced.

of Trent water, the samples having been taken from the river at different places and under different circumstances. These analyses go to show the varying chemical composition of the water in the Trent. But it does not need chemical analysis to prove the contamination of the river by excrement from a variety of sources; indeed the facts I have adduced go far to prove the specific pollution of the Trent by the bowel discharges of enteric fever patients from Newark and Gainsborough as well as from other places. In this connexion I may mention an instance which goes to show that even before the Trent reaches Newark its waters have become specifically polluted. Mr. Appleby, one of the leading practitioners in Newark, tells me he was called a few years ago to attend some men employed by the Trent Navigation Company in deepening the river's channel. These men while thus employed drew their drinking water from the Trent a little distance above Newark. Within a month Mr. Appleby was called upon to treat six of them for enteric fever, due, in that gentleman's opinion, to drinking the river water without first boiling it.

From the many opportunities which it has of becoming specifically contaminated, the River Trent cannot be regarded as a safe source of water supply to any individual, or community, located on its banks. As showing how far this opinion has been locally recognised, it is only necessary to state that the towns of Newark and Gainsborough, which formerly drew their supply in the one case in part, and the other wholly, from the Trent, have abandoned this source. Both towns have sunk bore wells in the new red sandstone to provide supplies for their inhabitants. And it is evident that if the Trent is recognised to be unfit for supplying wholesome water as high up as Newark and Gainsborough, it must be much less fit to supply the villages now using it below Gainsborough, after it has been further polluted by the sewage of these two towns and in other ways.

Professor Percy F. Frankland in forwarding his analysis of samples of Trent water which had been sent to him by the Gainsborough Urban Sanitary Authority, gave the following opinion on the river water, taken *above* Gainsborough. After alluding to the excessive turbidity of the two samples sent him he goes on to say:—"They both contain large "quantities of organic matter, which is to a considerable extent of "animal origin, and therefore highly objectionable, and both samples "contain for river water a remarkably high proportion of ammonia, also "pointing to the presence of sewage. I can easily understand that the "river at the time samples were collected was in an exceptionally bad "state, but I have no hesitation in saying that a stream which can at "any time be so contaminated as this, is most undesirable for the "supply of a town, and that it would be a constant source of danger to "the health of the inhabitants." These remarks, intended for the Urban District of Gainsborough, apply in a still greater degree to the rural district situated on the riverside below Gainsborough town.

The use of Trent water for domestic purposes is now considerably less than in past years. The towns of Newark and Gainsborough, as already stated, have discontinued it, though the latter has during the present summer been making use again of the river supply temporarily, during the deepening of their bore well; the Trent water, in this instance, being pumped into settling tanks continuously at all states of the tide, and being filtered through 3 feet or more of sand and gravel before it is pumped to the town's reservoir.

Eight villages in the Gainsborough Rural District (*see* report on water supplies of the Gainsborough Rural District at page 110) derive their drinking water mainly from the Trent, as also do two villages in

MAP SHOWING THE COURSE OF THE TRENT AND ITS PRINCIPAL TRIBUTARIES

THROUGH 5 COUNTIES FROM ITS SOURCE TO ITS FALL INTO THE HUMBER.

Scale 8 Miles to 1 Inch.

To face page

the Thorne Rural District (*see* report on water supplies of the Thorne Rural Sanitary District at page 131).

There are also two villages in the Glanford Brigg Rural Sanitary District, which make use of water from the River Trent for domestic purposes, viz., Burringham (population at census of 1891, 565) and East Butterwick (population in 1891, 274). These villages in addition to the river water, use rain water collected in underground cisterns from the roofs of houses. There are also surface wells in many of the back yards. The water in these is hard and seldom used for drinking. Trent water is boiled before use in these two villages, and to this precaution may possibly be due the apparent immunity of the inhabitants from enteric fever. Since 1886, there have only been, so far as is known, two cases of enteric fever in Burringham, both occurring in 1888, and only one case in East Butterwick, and this occurred in 1886. For information regarding these two villages I am indebted to Mr. Maximilian Behrendt, of Burringham, the resident practitioner.

With regard to the incidence of enteric fever upon residents in riverside villages, Mr. T. B. F. Eminson, of Scotter, who, in his own person and in that of other medical members of his family, has a large and varied acquaintance with the habits and customs of the locality, including the Trentside, expresses an opinion that enteric fever more commonly attacks new comers who drink Trent water, than those who have been drinking it for years. His explanation is that, in all probability many native Trentsiders have had enteric fever in early life, and that, perhaps, the constant use of Trent water by those who have not had the fever, enables them in some way to resist more or less this disease.

Though public opinion in towns is sufficiently advanced to recognise the danger of using a polluted water supply, it is unfortunately the case that in rural districts, and more especially in the Trentside villages, there is a strong feeling against the disuse of the river supply and the substitution of a new one. Apart from the question of expense, and the ignorance of the ill effects produced by contaminated water, there is in the district a deep rooted confidence in the qualities of Trent water, and an unconcealed aversion to listen to any representations as to possible dangers arising from its use. The medical men practising in the district are constantly urging the boiling of river water before use, and to this precaution, I think, in some measure is due the fact that there has not been a still greater incidence of enteric fever in recent years in these riverside villages.

It is of interest to mention that sand and gravel are taken from the river bed between Newark and Gainsborough and removed to towns for renewing the filtering materials of some public water supplies. Unless previous to use these materials are subjected to careful preparation, they might themselves become a source of danger.

Should cholera be introduced into this country at any time, and be carried to any of the towns or villages situated on the banks of the Trent or its numerous tributaries, the people who drink Trent water lower down would be in danger of catching the disease. I am informed that in some previous cholera visitations the Trentside populations suffered heavily. Attached is a map showing the course of the Trent and some of its tributaries.

App. A. No. 3.

Report on River Trent and Lakes and Notts, with [illegible] to Water Supplies and Enteric Fever, by Dr. Bruce Low.

On the Water Supplies of the Gainsborough Rural Sanitary District, in their Relations with Enteric Fever.

II.

ON THE WATER SUPPLIES OF THE GAINSBOROUGH RURAL SANITARY DISTRICT, IN THEIR RELATIONS WITH ENTERIC FEVER.

Repeated reference in the annual reports of the Medical Officer of Health of the Gainsborough Rural Sanitary District, to prevalence of enteric fever among the population of villages on the banks of the Trent, who drink the river water, has been the subject of correspondence between the Local Government Board and the Sanitary Authority during several years. In 1892, as a result of this correspondence, the Rural Sanitary Authority passed a resolution committing the matter of water supplies in riverside villages to the consideration, of the parochial committees or vestries of the several parishes, with a request for observations, and indicating that copies of any resolutions passed at meetings of these bodies should be sent to the Rural Sanitary Authority. Accordingly local meetings in the riverside villages were held and resolutions passed, copies of these resolutions being subsequently sent by the Rural Sanitary Authority to the Local Government Board (see Addendum). They were generally to the effect that the Trent water was wholesome and not injurious to health, and that consequently it was undesirable to take any steps towards obtaining a different supply. It was also stated that no complaints had been made by the inhabitants of riverside villages, who preferred Trent water to any other. On receipt of these resolutions the Local Government Board wrote to the Sanitary Authority pointing out that they (the Rural Authority) and not the parochial committees or vestries were responsible for the water supplies of the district; and adding that the fact that the villagers themselves were satisfied with a supply which was known to be polluted, did not relieve the Sanitary Authority from their duty, under section 5 of the Public Health (Water) Act, 1878, of seeing that every inhabited house in the district had within a reasonable distance a sufficient supply of wholesome water. The especial danger of using polluted water was pointed out in the event of cholera appearing in this country. To these representations the Rural Sanitary Authority contented themselves by replying that they saw no way out of the difficulty unless sewage and offensive trade refuse could be prevented from going into the Trent in localities above, and outside of, their jurisdiction.

Thus the matter stood at the end of March of the present year (1893), when the annual report of the Medical Officer of Health (Mr. Wright) was received by the Board. In this report mention was again made of the occurrence of enteric fever in the district, due, it was said, in certain instances, "to the drinking of unfiltered Trent water." After consideration of this report the Local Government Board decided that the circumstances of the Gainsborough villages, their water supplies, and the prevalence in them of enteric fever, should be investigated by the Medical Department, and I was instructed to make the inquiry.

Topography.

The Gainsborough Rural Sanitary District is situated in the north-west of Lincolnshire, and includes within its borders a small portion of the county of Nottingham. It is bounded on the north and east by the Glanford Brigg Rural District, on the east by the Lincoln Rural

District, on the west by the Thorne and East Retford Rural Districts, and on the south by the Newark Rural Sanitary District. It comprises the whole of the Gainsborough Union and Registration District, except the Urban Sanitary District of Gainsborough which is situated somewhere about the centre of the Rural District.

At the last census the population of this Rural Sanitary District numbered 18,756 persons (an increase of 677 since the census of 1881), distributed over 50 parishes. The area is 104,210 acres, and the rateable value in December 1892 was 144,247*l.*

The River Trent flows through the extreme length of the district, a distance of over 20 miles, in a direction almost due south to north. Two canals, one in the southern, the other in the northern portion of the district, connect the Trent with certain inland towns. The land in the vicinity of the river is flat.

The people are chiefly engaged in agriculture. Much of the land, more especially near the Trent, is exceedingly fertile. There are some chemical works at East and West Stockwith, which in busy times give employment to several hundreds of hands, but at present the works are not in full operation. Some persons living beside the Trent find employment on board barges or other river craft.

Geologically, the western part of the district is on the New Red or Keuper Marl, for the most part concealed by more recent beds of warp, sand, and peat. Near the town of Gainsborough it stands on the Upper Keuper beds; above the Keuper come the Rhaetic beds, then the Liassic Limestones and Clays, and on the eastern borders of the district the Oolites, forming a line of hills called "the Cliff." The strata dip to the east. The Trentside villages stand on river alluvium deposits which cover the Upper Keuper beds.*

General Sanitary Circumstances.

Dwellings are of much the same type as is met with in other rural districts of the Northern Midlands. As a rule they are fairly clean and in good repair, but occasionally are dirty and dilapidated. Some are damp from want of eave spouting. A few have no back doors or windows, and therefore can have no free through-ventilation. In some riverside villages the houses are packed in an irregular manner together, and have not sufficient open space around them. These have little or no garden ground attached, though generally speaking the cottages have gardens and allotments. Cases of overcrowding, I am informed, occur now and again. Many yards are unpaved or otherwise unprotected from soakage.

Sewerage.—Most of the larger villages have been sewered. The outfalls usually discharge into open ditches or watercourses which ultimately, sooner or later, reach the Trent. Recently sewerage has been improved and relaid at Sturton and Blyton, where the old-fashioned horse-shoe tile pipes have been replaced by 9-inch glazed and socketed pipes.† Usually, little provision has been made for ventilation of sewers, but at Scotter several upright shafts have been fixed at certain points for this purpose. It is proposed to ventilate the new Blyton

* For information on the local geology of the district, I am indebted to F. M. Burton, Esq., of Highfield, Gainsborough.

† In addition to the above the following villages have had special sewers laid since 1885, when the present Medical Officer of Health came into office, viz., Bole, Corringham, Fenton, Glentworth, Haxey, Lea, Misterton, Morton, Marton, Scotter Scotton, Stowe, Upton, and Willingham.

sewer in the same manner. No manholes or lamp holes at bends or junctions have been provided for inspection purposes. Usually no arrangements for flushing the sewers have been made; but at Owston Ferry, where the sewer is an old square-shaped one, built of brick, and with little or no gradient, there is a contrivance by which at high tide water can be admitted from the river into one section of the sewer, permitting a free flush from end to end, when desired. A few houses at Misterton drain direct into the Chesterfield Canal. In some places house drainage is imperfect; occasionally slops are conveyed away in open channels. Trapped gulleys were sometimes seen outside the dwellings for the reception of the house slops; but small shallow metal traps were more commonly met with. Where no sewers are provided each house drains into the nearest ditch, or sometimes into a cesspool in the garden.

Excrement disposal is mainly by midden-privies, most of them of defective construction. Many privies discharge into large uncovered middens, which retain for long periods considerable accumulations of filth and refuse. Privies are sometimes dilapidated, some are without doors. Nearly all permit the dripping of rain water from their roofs to pass direct into the middens. Occasionally, owing to want of spouting on the adjoining buildings, the storm water therefrom runs into the midden pit. Some privies are too close to dwellings. One midden, for example, at West Stockwith, is only 4 feet from a house, the privy door facing the pantry. Into this midden, four privies (used by eight houses) discharge. It is uncovered, is sunk 3 feet or more below the surface of the ground, and measures 8 feet long by 5 feet wide. Slop water is thrown occasionally into these midden pits, the bottom of which is seldom water tight. A few houses, at Morton for example, have moveable receptacles in their closets, but owing either to apathy on the part of the occupier, or to the want of suitable opportunities for disposing of the contents, those that I saw were not always in good order.

The removal of House Refuse is cast upon the occupier, and it would seem, judging from results, that in the opinion of the occupier, the larger the midden the less frequent the trouble of getting it emptied. I saw numbers of middens in urgent need of emptying. In some instances inquiry elicited the fact that the occupier had no garden or allotment on which to dispose of his refuse, and that he was thus at the mercy of the farmer, who would only remove the refuse when it suited his own convenience. Some householders in riverside villages throw their refuse direct into the Trent, or dispose of it upon the river banks from which it is carried away by high tides. For some cottage property no ashpits of any kind are provided, and house refuse is heaped in the backyard.

Pigs are sometimes kept too close to houses. Some sties at the time of my visit were in a wet and neglected state, and from their proximity to wells endangered local water supplies.

Water supply.—Throughout the whole district, this is in a large measure derived from pump wells, one for each house or group of houses. The wells vary in depth, some being not more than 10 feet deep, while one at Lea is 50 feet deep. The average depth is from 15 to 20 feet. Many of them from their situation are liable to contamination owing to soakage into them of liquid from privy pits, middens, and [illegible]. Where the position of the well has been properly chosen, and where there are no filth accumulations near at hand, these wells appear to be not unsatisfactory; but a large number are not so situated as to be free from danger of pollution. Some wells at Morton, for example, become discoloured after heavy rains. Some outlying cottages

in Kexby parish get their water supply from a land drain. This water, I was assured, is always boiled before use.

The village of Misterton derives its water supply in large part from the Chesterfield Canal, and a small portion of the parish of Walkeringham does the same. This canal joins the Trent at West Stockwith about a mile from Misterton. The water in the canal is polluted. A considerable amount of nightsoil manure is brought into the canal, by barges, from Lincoln and Gainsborough in the one direction, and from Retford in the other. A good part of this manure is unloaded on the banks of the canal, and pollution of the water takes place in the process. At Misterton there are some pump wells, and also rain water is stored in cisterns by some persons, but the majority of the people use the canal water; some boil it, but others do not.

None of the villagers on the riverside above Gainsborough drink Trent water, though persons (eel-fishers with their families, and others) living in house boats and moored off one or another of the riverside villages habitually use it. The more or less habitual use in the Gainsborough Rural District of Trent water for domestic purposes, is limited to eight villages all situated below the town of Gainsborough. Their combined population at the last census amounted to 3,530, of whom 878 live in five small villages on the east bank of the Trent; and 2,652 in three larger villages on the west bank. The first group comprises the villages of Walkerith, East Stockwith, Wildsworth, East Ferry, and Susworth, while the second group consists of West Stockwith, Owston Ferry, and West Butterwick. (For population of each village see Table III., pages 117–18.)

The water when drawn from the Trent is brown or yellowish-brown in colour, and somewhat muddy looking. It is commonly set aside for a time by the householders to stand in large jars holding six or eight gallons or more, to allow the abundant suspended matter to settle. After this it is usually boiled before use. Some persons after boiling filter it, others only filter it without boiling; while there are people who neither boil nor filter the water, resting content to use it after allowing the suspended matter to subside. Even in households where the Trent water is habitually boiled before use, it is admitted that there are occasions when this precaution, for various reasons, is omitted. In one village, Susworth, it is the custom of some to add a little alum to the muddy water, to hasten the settling down of the sediment to the bottom of the jar.

The filters in use in these villages are generally made of carbon, or of sandstone. While some persons are careful to clean their filters regularly, others take little trouble with them; one man indeed confessed to me that his filter had not been cleaned for two years. Several of the filters used were of a kind that cannot be taken to pieces for the purpose of being cleaned. In such cases the householder was satisfied with only washing the sponge placed at the top of the filter in the opening through which the water enters the filter.

At some farmhouses situated on the river's banks the water is pumped direct from the Trent to the house through a leaden pipe laid through the bank into the bed of the river. Commonly, however, water is drawn by hand in buckets or pails from the banks or from any convenient boat-landing. Water is taken at all states of the tide. Even at high tide the water is said not to be brackish. For convenience water is taken generally in the Gainsborough rural district at high water, especially during spring tides; for when the tide recedes a copious deposit of slimy mud covers the banks and landing stages,

causing them to become slippery and unsafe for water-drawers, who have occasionally been known to get immersed in the river while filling their vessels.

Persons "born and bred" on the Trentside have a very high and exaggerated estimate of the river water. Regarding it as wholesome and harmless, they are deaf to any representations of the possibility of its being specifically contaminated before it reaches them. On the other hand, visitors to the district, or persons newly coming to live in the district, have at first some difficulty in overcoming their aversion to the muddy looking water. Locally the "Trentsiders" regard use of river water as conducive to longevity.

In addition to the river water many of the cottagers and others in these villages have rain water cisterns in which "soft" water is stored. A few of these are made of metal and stand above ground, but the majority are underground, made of brick and cemented inside. At the date of my visit, owing to the prolonged dry weather, most of the underground cisterns were empty. On looking down into some of them I saw places where the cement had cracked, and where percolation from the adjacent soil was taking place. Commonly these cisterns were situated close to the back doors of houses, and in numerous instances they were only a few feet distant from the privy-midden.

This "soft" water, often dark and smelling unpleasantly, is used chiefly for washing: but some people after boiling and filtering it use it for drinking purposes. The cisterns are generally cleaned out once a year in the dry summer weather, when they are often empty or nearly so. Some of the poorer cottagers collect rain water from the downfall pipes in barrels, but the water in these wooden receptacles soon becomes green in colour and smells offensively.

There are also in the riverside villages pump wells attached to some houses or yards. The objectionable position of these wells renders them liable to pollution, and as matter of fact some of them are regarded as polluted, and are not used except for "swilling" the floors. The water in them is hard and but few persons use them for domestic purposes, the general preference being, throughout the riverside villages already named, for Trent water.

To recapitulate, it may be stated, generally, that the majority of the villages in the Gainsborough Rural District are provided with pump wells, the water from which is used for all domestic purposes. One large village, Misterton, mostly uses canal water, as also does part of an adjacent parish, Walkeringham. Finally, eight riverside villages below Gainsborough town make use more or less of water taken from the River Trent.

Sanitary Administration.—The Gainsborough Board of Guardians are the Rural Sanitary Authority, and their administrative staff comprises a medical officer of health, Mr. H. Wright, and an inspector of nuisances, Mr. W. Eyre, who is also surveyor and canal boat inspector. The medical officer of health receives a salary of 50*l.* per annum, no part of which is repaid from County funds.* He possesses an adequate knowledge of the deficiencies of his district; but he receives small encouragement from his Authority to push forward sanitary improvements. The inspector of nuisances receives an inclusive salary of 80*l.* per annum, but is permitted to practise as an architect. His duties are discharged satisfactorily. He does not, however, always receive the

* Since this was written the Sanitary Authority have increased Mr. Wright's salary to 80*l.*, in response to his application for better remuneration.

support he is entitled to in his efforts to place the sanitary condition of the district on a better footing.

The Authority have adopted byelaws with regard to the regulation of common lodging-houses, the level and width and construction of new streets, the structure and the ventilation of new buildings, the drainage of new buildings, and as to construction of waterclosets, privies, ashpits, and cesspools in connexion with new buildings, as to slaughter-houses, as to nuisances arising from snow, filth, dust, ashes, and rubbish, and as to the keeping of animals. All of these were allowed by the Local Government Board as far back as August 11th, 1877; but practically the byelaws are not enforced. Regulations have been made under the Dairies, Cowsheds, and Milkshops Order of 1885.

The Infectious Disease (Notification) Act, 1889, has not been adopted, nor have any powers been sought under the Infectious Disease (Prevention) Act, 1890, or under the Public Health Acts Amendment Act, 1890.

The Rural Sanitary Authority have no permanent accommodation for the isolation of acute infectious diseases, but some years ago a hospital marquee for patients and a bell-tent for the nurse were purchased for the purpose. I understand that they have not been used. From time to time the tents are brought out and aired so as to be available if wanted.

There is no proper means provided for the thorough disinfection of clothing, bedding, &c. Fumigation by sulphur, I am informed, is practised to disinfect houses after the occurrence of infectious disease in them.

Enteric Fever.

This disease has been present in the Gainsborough Rural District more or less for a number of years; deaths from this cause have been registered in every one of the last 10 years, 1883 to 1892 inclusive, with one exception, viz., 1887. The numbers are not large, it is true, but they show persistence of the disease in the district. Table I. shows the deaths from enteric fever in the Rural Sanitary District of Gainsborough during each of the last 10 years, 1883 to 1892 inclusive.

Table I.

1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.	1892.
5	4	5	3	—	3	2	8	3*	5

* One of these was certified from "continued fever."

I learn from medical men practising in the district that in some villages, such, for example, as Scotter, enteric fever was formerly much more frequently met with than of late years; and this change was generally believed to be due to the carrying out of sewerage works in the particular villages referred to. Among local practitioners a general opinion was expressed that while sewerage schemes had benefited certain portions of the district, yet little or no improvement as regards diminution of enteric fever had taken place in the riverside villages. On my arrival in the locality I made an attempt to obtain full details of enteric fever incidence in one and another portion of the whole rural district. But I found that for various reasons there was much difficulty in getting information. Notification of infectious diseases was not in force, and, from one cause or another, cases of fever had not always been

App. A. No. 9.

On the River Trent in Linca. and Notts., with reference to Water Supply and Enteric Fever. By Dr. Arthur Low.

On the Water Supplies of the Gainsborough Rural Sanitary District, in their relations with Enteric Fever.

brought under the notice of the medical officer of health. Unfortunately, at the date of my inquiry, Mr. Wright, the medical officer of health, was unavoidably absent from home, and I lost the assistance this gentleman might have given me, though his deputy, Mr. Passmore, rendered me every help in his power. Finally I obtained, after the expenditure of much time and trouble, particulars of cases from all the medical men living and practising in the different parts of the rural district. I soon found that my inquiries would have to be limited to the last 4½ years. The lists had to be prepared in some instances from memory, and with this result:—Where a practitioner was having groups of cases every year, some of them club patients of whom no record was kept in the ledger or day-book, the lists of actual cases were admittedly incomplete; but where on the other hand the medical men met with sporadic cases only, sometimes not more than one in two years, the facts as to each occurrence remained in their memories, and their list of cases was much more complete. I have considered it right to make this statement, as, further on, I shall have to point out an inequality of incidence of enteric fever in certain localities, the inequalities being for the above reason even more pronounced, so it is believed, than is shown by the figures.

In the following table I have placed the number of cases reported to me by the local medical men as having occurred in their several practices during the last 4½ years. For purposes of comparison I also give the number of cases which came under the notice of the Medical Officer of Health (taken from his annual reports) for the same period. A consideration of the two sets of figures will show that the Sanitary Authority were imperfectly informed as to the amount of preventable illness occurring in the district under their care, and that consequently their officials, no matter how active or willing, could not take the necessary steps to check the further spread of the infection. The insufficiency of information might have been obviated more recently had the Rural Sanitary Authority adopted the Infectious Disease (Notification) Act of 1889.

Table II.—Showing the Number of Enteric Fever Cases reported during the inquiry as having occurred in Gainsborough Rural Sanitary District during the 4½ years ended June 30th, 1893; and showing also the Total Number of such Cases that came under the notice of the Medical Officer of Health during the same period. (Population 1891, 18,756.)

———	1889.	1890.	1891.	1892.	First Half, 1893.	Total.
Cases of enteric fever heard of during the inquiry.	35	52	40	47	18	192
Cases which had come under the notice of Mr. Wright, Medical Officer of Health.	12	11	3	10	—	36

As has been stated, this list of cases is not to be taken as representing the full extent of enteric fever occurrence in the Gainsborough Rural District, the lists having been compiled in some instances from memory, but for the reasons above noted it will serve, when examined and analysed, to indicate the different incidence in one and another locality within the district. For this purpose I have placed in Table III. the

On the River Trent in Lincs., and Notts, with reference to Water Supply and Enteric Fever; by Dr. Bruce Low.

On the Water Supplies of the Gainsborough Rural Sanitary District, in their Relations with Enteric Fever.

whole of the parishes in the rural district, with their populations and the number of cases noted as having occurred in each of them during the last 4½ years.

In addition to the above cases, it was stated to me by a practitioner having a large practice, part of which was in riverside villages, that he frequently met with attacks in these villages, having as leading features diarrhœa attended with some fever, but only lasting 10 days or even less. These cases he regarded as due to the same poison as enteric fever, but as very mild or abortive cases.

TABLE III.—Showing incidence of Cases of ENTERIC FEVER during the last 4½ years (to June 30th, 1893) in each of the several Parishes in the Rural Sanitary District of Gainsborough.

Parish or Village.	Population (1891).	1889.	1890.	1891.	1892.	First Half, 1893.	Total.	Remarks.	—
Thonock	96	—	—	—	—	—	—	—	
Bole	177	—	—	—	—	—	—	—	
Blyton and Wharton	747	—	—	—	—	—	—	—	
Beckingham	492	2	—	—	2	—	4	—	
Brampton	94	—	—	—	—	—	—	—	
Blyborough	213	1	—	—	—	—	1	—	
Burton Gate	118	—	—	—	—	—	—	—	
Burton, West	52	—	—	—	—	—	—	—	
Corringham	704	—	—	—	—	—	—	—	
Coates	54	—	—	—	—	—	—	—	
Fenton	238	—	—	—	1	—	1	—	
Fillingham	283	—	—	—	—	—	—	—	
Glentworth	316	—	—	—	—	—	—	—	
Grayingham	158	—	—	1	—	—	1	Imported case.	
Greenhill and Redhill	27	—	—	—	—	—	—	—	
Heapham	132	—	—	—	—	—	—	—	
Hardwick	78	—	—	—	—	—	—	—	
Hemswell	338	—	—	—	—	—	—	—	
Haxey	1,855	3	—	3	1	1	8	One imported case; and five cases in two houses.	These 38 villages are supplied with water from local wells.
Kexby	314	—	—	—	—	—	—	—	
Kettlethorpe	196	—	—	—	—	—	—	—	
Lea	188	—	—	—	—	—	—	—	
Laughton	300	—	—	—	—	—	—	—	
Marton	376	—	—	—	—	—	—	—	
Newton*	307	—	—	—	2	—	2	Both in one house.	
Northorpe	196	—	—	—	—	—	—	—	
Pilham	60	—	—	—	—	—	—	—	
Scotter (not including Susworth).	928	3	1	—	—	—	4	One imported	

* The village of Newton, generally called Newton-on-Trent, is a quarter of a mile or more from the river, and is not therefore here classed as a riverside village.

Parish or Village.	Population (1891.)	1889.	1890.	1891.	1892.	First Half, 1893.	Total.	Remarks.	—
Scotter	219	—	—	—	—	—	—	—	
Scotthorpe	44	—	—	—	—	—	—	—	
Stowe	289	—	—	—	—	—	—	—	
Springthorpe	176	—	—	—	—	—	—	—	
Spurton and Bransby	572	—	—	—	—	—	—	—	
Upton	199	—	—	—	1	—	1	Imported case.	
Willingham	406	—	—	—	—	—	—	—	
Willoughton	467	—	—	—	—	—	—	—	
Scundly	126	—	—	—	—	—	—	—	
Harpswell	120	—	—	—	—	—	—	—	
Torksey	195	—	—	—	1	1	2	Both cases in house-boats on the Trent.	These three villages are on the Lincolnshire side and are supplied with water from local wells.
Knaith	86	—	—	—	—	—	—	—	
Morton	1,137	—	—	1	—	—	1	"Continued fever" probably imported.	
Walkerith	85	—	—	—	—	1	1	—	
East Stockwith	392	3	1	2	1	1	8	—	
West Stockwith	723	8	12	15	9	3	47	—	These eight riverside villages are situated on the Trentside below Gainsborough. Their water supply is from wells at distances from 30 to 300 yards from the river.
Wildsworth	118	—	—	—	1	—	1	—	
East Ferry	133	—	—	1	9	—	10	—	
Owston Ferry	1,276	4	23	1	3	1	32	—	
Susworth	150	—	—	1	1	2	4	—	
West Butterwick	653	—	1	2	6	4	13	—	
Misterton	1,411	6	10	13	7	3	39	—	Water supply partly from canal and partly from wells.
Walkeringham	752	5	4	—	2	1	12	—	
	18,756	35	52	40	47	18	192		

Owing to the difficulty met with in obtaining full and accurate details as to definite dates of attack, &c., it has been found necessary to limit my remarks to general observations on the incidence of enteric fever on different portions of the district, without special reference to outbreaks in one or another locality.

The 51 villages or parishes* in Table III. are roughly divisible into four groups:—1. Villages, to the number of 38, whose water supply is from local wells, and which are not near to the river. 2. Villages numbering three, which, though situated on the river banks, do not use the Trent water, but have pump wells. 3. The Trentside villages, numbering eight, whose main supply is from the river. 4. Two villages, one of which and a portion of the other, derive their water supply from the Chesterfield Canal.

1. The incidence of enteric fever on the first of these groups of villages is shown in Table IV.

* Although the number of parishes is given as 50 on page 111, the sub division of Scotter into two parts (Scotter and Susworth) has been found necessary. Susworth, population about 150, is in the parish of Scotter, but is three miles distant from that place, and is practically a distinct Trentside village.

TABLE IV.—Showing the Incidence of ENTERIC FEVER on a Group of 38 Villages in the Gainsborough Rural Sanitary District during the last 4½ years (ended June 30th, 1893), whose Drinking Water was got from Local Wells.

—	Population. (1891).	1889.	1890.	1891.	1892.	First Half, 1893.	Total, 4½ Years.
Cases of enteric fever in 38 villages supplied with water from local pump wells.	11,645	9	1	4	7	1	22
Rates of attack per 1,000 living.	—	0·80	0·085	0·35	0·60	0·08	0·42

The fever cases were confined to seven out of the 38 villages. These invaded villages were scattered throughout the district on both sides of the river, on high ground, and on the flat country.

Out of the 22 recorded enteric fever cases, inquiry had referred four of them to importation from a distance; and five others were secondary cases occurring in the houses to which infection had been thus imported.

2. The second group comprises three villages, which are situated on the banks of the Trent, but which do not make use of the Trent water for domestic purposes. These villages are Torksey and Knaith, situated above Gainsborough town, and Morton, which is a mile below it and is practically a suburb of Gainsborough. To this last village the town water mains extend, but the majority of the inhabitants use water from local wells, as do those of the other two villages in the group.

In this second group the amount of fever occurring recently is shown in the following table:—

TABLE V.—Showing the incidence of ENTERIC FEVER during the last 4½ years ended June 30th, 1893, on a Group of Three Villages situated on the Trentside, but not using the River as a Water Supply.

—	Population (1891).	1889.	1890.	1891.	1892.	First Half, 1893.	Total, 4½ Years.
Cases occurring in three villages on the Trentside, not using river water for domestic purposes.	1,418	—	—	1*	1†	1‡	3
Rates of attack per 1,000 living.	—	0·0	0·0	0·7	0·7	0·7	0·47

* Fatal, and certified as "continued fever" at Morton.

†‡ These two cases occurred on board house-boats, moored in the Trent off Torksey, and the patients habitually drank water from the river.

App. A. No. 9.

On the River Trent in Lincolnshire and Notts with reference to Water Supply and Enteric Fever; as Dr. Ballard's Letter.

On the Water Supplies of the Gainsborough Rural Sanitary District, in their Relations with Enteric Fever.

Two, at least, out of a total of three cases recorded in 4½ years, occurred under circumstances completely different to those of the rest of the population. Both cases were male adults living on boats, and both admitted their habitual use of unboiled Trent water for drinking purposes. It is of interest to mention that during the course of the illness in each case, and in accordance with habitual practice, the bowel discharges were thrown overboard into the river.

3. The third group comprises eight villages, situated on the banks of the Trent below Gainsborough, the inhabitants of which are in the habit of using water for domestic purposes. These villages stand on either side of the river a few miles distant from each other, and the most distant of them is not more than 12 miles from Gainsborough. The following table shows the extent to which these eight villages have suffered from fever :—

TABLE VI.—Showing the Incidence of ENTERIC FEVER during the last 4½ years ended June 30th, 1893, on Eight Trentside Villages which obtain their Water Supply from the River.

——	Population (1891).	1889.	1890.	1891.	1892.	First Half, 1893.	Total, 4½ Years.
Cases of enteric fever in eight villages on the Trentside, obtaining water supply from the river.	3,530	15	37	22	30	12	116
Rates of attack per 1,000 living.	—	4·2	10·4	6·2	8·4	3·3	7·30

No information was forthcoming as to whether any of the cases referred to had been imported ones.

4. The amount of recorded enteric fever occurring in the fourth group, viz., two villages supplied more or less with water from the Chesterfield Canal, is shown in the subjoined table :—

TABLE VII.—Showing the Incidence of ENTERIC FEVER during the last 4½ years ended June 30th, 1893, on Two Villages getting their Drinking Water more or less from the Chesterfield Canal.

——	Population (1891).	1889.	1890.	1891.	1892.	First Half, 1893.	Total, 4½ Years.
Cases of enteric fever in two villages obtaining canal water as part of their supply.	2,163	11	14	13	9	4	51
Rates of attack per 1,000 living.	—	5.0	6·4	6·0	4·1	1·8	5·24

The two villages in the fourth group are Misterton and Walkeringham. Walkeringham lies about a mile from and west of the Trent; a few of its houses here and there abut upon the river, and the people in them use

Trent water. The Chesterfield Canal runs behind the village, to the west of it. Only inhabitants of some outlying parts of the parish use the canal water, but these persons have suffered heavily from fever. For example, one medical man gave me particulars of 10 cases in the parish, and of these seven habitually used canal water.

Misterton is a large and straggling village, the main part of which lies about a mile from the Trent. A portion of the parish abuts upon the river, and is practically a part of the village of West Stockwith, though separated from it by the River Idle which joins the Trent at this point. Some persons, estimated at about 150, in this part of Misterton use Trent water.

The bulk of the people of Walkeringham have pump wells, while at Misterton wells are not so numerous, nor does the water afforded by them stand high in public opinion, a general preference being expressed for the softer water of the canal.

The Chesterfield Canal, which passes through the parishes of Misterton and Walkeringham, joins the Trent at West Stockwith, where are a lock and canal basin. Inland beyond Misterton, and to the south-west, the most important place on the canal is Retford, whence cargoes of nightsoil are brought in barges for disposal on the celery-growing land in and round about Misterton parish. From the south-east cargoes of nightsoil are also brought into the Chesterfield Canal from Gainsborough, and from Lincoln *viâ* the Foss Dyke, another canal which joins the Trent at Torksey. (*See* General Map.)

This nightsoil along with towns' manure is unloaded on the banks of the canal in Misterton parish, sometimes close to the village, and some of the filth is usually spilt into the water and on the banks during the process of unloading. The nightsoil before being carted away is heaped up on the bank, a few feet from the water's edge, and eye-witnesses inform me that they have seen the liquid filth exuding from the heap, running directly into the canal. The bilge water remaining in the barges after unloading is pumped out into the canal. The amount of nightsoil manure passing *viâ* the canal from the River Trent is estimated at from 500 to 600 tons in the year; this does not include that which comes from Retford in the other direction. Of this latter I have no accurate information, but I hear as regards that town that the nightsoil is usually sent away from there in canal boats. About two-thirds of Retford cottages have privies, while the remaining third have pail closets.

The Medical Officer of Health for the borough of East Retford, Mr. Walter Spencer, informs me that enteric fever is not a common disease in that town, though cases occasionally occur. The borough has a pure water supply. No deaths from enteric fever have been recorded in Retford during the last 3 years, but the following cases were notified to the Medical Officer of Health during that period:—

Table VIII.—Showing notified Cases of Enteric Fever in the Borough of East Retford during 1890, 1891, and 1892.

—	Population (1891).	1890.	1891.	1892.	Total in 3 Years.
Cases of enteric fever in borough of East Retford.	10,603	9	3	7	19

Though these numbers are small they suffice to indicate the possibility that the water of the Chesterfield Canal receives specific pollution at times from this source, as well as by means of nightsoil brought from other directions, viz., from Gainsborough and Lincoln, where also enteric fever is known to occur from time to time. On the occurrence of enteric fever in these two places I have already remarked, when speaking of pollution of the River Trent, on the banks of which nightsoil manure is also unloaded.

Summarising now the facts as to fever attacks in each of the four groups of villages in Gainsborough Rural Sanitary District, a far greater incidence is found on the populations using the Trent and the canal water than on the populations using other supplies. This is shown in Table IX.

TABLE IX.—Showing the Rates of ENTERIC FEVER Attack per 1,000 living, in each of the Four Groups of Villages in the Gainsborough Rural Sanitary District, during the last 4½ years.

—	Population (1891).	1889.	1890.	1891.	1892.	First Half, 1893.	Totals.	Average Annual Rate.
I. 38 villages with pump wells away from the Trent.	11,645	0·7	0·08	0·3	0·6	0·08	1·90	0·42
II. 3 riverside villages using wells.	1,418	0·0	0·0	0·7	0·7	0·7	2·13	0·47
III. 3 riverside villages using Trent water.	3,630	4·2	10·4	6·2	8·4	3·3	32·86	7·30
IV. 2 villages partly using canal water.	2,163	5·0	6·4	6·0	4·1	1·8	23·11	5·24

This is further illustrated by reducing the four groups to two, viz., those on the one hand using well water, and those on the other hand using river or canal water.

TABLE X.—Showing Rates of ENTERIC FEVER Attack per 1,000 Inhabitants living in Two Groups of Villages in the Gainsborough Rural Sanitary District during the last 4½ years, classed according to their Water Supplies.

—	Population (1891).	1889.	1890.	1891.	1892	First half, 1893	Totals
41 villages using well water	13,063	0·6	0·0	0·3	0·6	0·1	1·92
10 villages, using mainly water from the Trent or from the Chesterfield Canal.	5,693	4·5	8·9	6·1	6·8	2·8	29·3

In short, of the total 192 cases contributed to the list on page 111 by the medical men living and practising in the Gainsborough Rural District, no fewer than 167, or 86·9 per cent., occurred among a popula-

tion under 6,000 living in villages the main water supply of which was drawn from admittedly polluted sources, viz., the River Trent, or the Chesterfield Canal; whereas only 25 cases, or 13·0 per cent. of the whole, were heard of in an aggregate population of a trifle over 13,000 living in 41 villages using water from local pump wells.

In my General Report on the circumstances of the River Trent in Lincolnshire and part of Nottinghamshire, I have already given a detailed account of ways in which the water in the river can become specifically polluted. As regards, therefore, the villages situated on the Trent below Gainsborough, and drawing their water supply mainly from the river, these are evidently in a position of considerable danger, especially in the event of cholera being imported into this country and being carried to any of the inland towns or districts draining into the Trent. This serious danger, as well as the danger already pointed out in this report as to enteric fever (which is spread much in the same way as cholera), should stimulate the Rural Sanitary Authority to take steps to secure a safe and wholesome water supply for these riverside villages, and to this end skilled assistance should be called in without delay.

Various proposals have been made locally, viz., to (1) pump the river water at each village into settling tanks, and then pass it through filter beds constructed of sand and gravel; (2) to take water from the River Idle above its tidal portion and to pipe it from a reservoir to each village (but as to this proposal it must be remembered that the sewers of Retford discharge into the Idle above the point at which water would be taken, and that the river drains a large tract of heavily manured land); (3) to sink one or more deep bore wells for each village or group of villages.

Whatever steps are taken by the Rural Sanitary Authority of Gainsborough to secure for these villages a pure water supply, endeavours should be made to educate and lead public opinion in this matter. The deeply rooted but misplaced confidence which the Trentside people have in their present supply from the river is not easily shaken, while the prospect of the expenditure of any money at all at once raises opposition to any suggested schemes for the improvement of the water supply. Notwithstanding these and other hindrances, the duty of providing the district with pure supplies of drinking water is urgent, and it should no longer be evaded by the Rural Sanitary Authority of Gainsborough. In the meantime the best means of ensuring the safety of the riverside populations and of those drinking polluted canal water is to boil all water used for drinking purposes, as already recommended by the Medical Officer of Health.

There will be found appended copies of the resolutions passed by the parochial committees at the local meetings in riverside villages in 1892, on the subject of water supplies.

Two maps (Nos. 2 and 3) showing the course of the Trent through the Gainsborough Rural Sanitary District are also attached.

July 31, 1893.

P.S.—Since the above report was written a fatal case of cholera has occurred at Morton. The history of the case suggested importation of infection from Hull, where one of the members of the family had recently been visiting. Death took place 19 hours from the onset of the symptoms. The nature of the malady was at once recognised by the medical attendant, Mr. Passmore. Mr. Wright, M.O.H., who also saw the case concurred. A post-mortem examination was made, and a portion of intestine sent to Dr. Klein, who after cultivation experiments

verified the diagnosis. There occurred also two concurrent cases of "diarrhœa" in the same house. Prompt precautionary measures were taken by Mr. Wright, and by Mr. Eyre, the Inspector of Nuisances. The family of the patient were moved after his death to lodgings, while the house underwent a thorough disinfection. Lime-washing and re-papering were also done. Clothes and bedding were burnt and compensation paid. The well was closed and also several others adjoining it, all being so situated as to make specific pollution of their water easy and probable. Mr. Wright recommended that the water from the Gainsborough town service should be used in Morton instead of water from surface wells. The mains of the town water supply are already laid in the streets of Morton. This supply, formerly taken from the Trent and supplied after filtration through sand, is now derived from a bore well, 1,350 feet deep, sunk in the New Red Sandstone. The amount at present that can be pumped from this deep well is estimated at 540,000 gallons per diem. There is, therefore, an abundance of pure water at hand in Morton, and there can no longer be any excuse for the continued use of water taken from shallow wells which are here so liable to be polluted by human excrement.

At Owston Ferry, since July, there have occurred some 50 or more cases of diarrhœa, and of these six have died with choleraic symptoms. The duration of the fatal illness varied, in different instances, from 2 to 10 days. All the deaths occurred in adults, three of whom were aged persons. No satisfactory evidence was forthcoming as to the precise nature of this illness. All the fatal cases occurred in the principal street, through which is laid the main sewer of the village. This sewer is of ancient construction, made of brick, square in shape, and with a very flat gradient. The roadway gulleys connected with it are either imperfectly trapped or not trapped at all. Complaints have been made of bad smells coming from these gullies. There is a contrivance to flush this sewer, at high tides, with water from the Trent by opening a sluice; but this is not often used, as the muddy river water silts up the bottom of the sewer. Some of the choleraic cases, I am informed by Dr. Steen, the resident practitioner at Owston Ferry, drank rain water, some drank well water, and some river water. Dr. Steen had four cases of enteric fever under his care in Owston Ferry during September. At Susworth, too, there have been, during September, at least three non-fatal cases of severe choleraic diarrhœa. Communication between all the Trentside villages and Hull is frequent and easy, and the possibility of importation of cholera to the district next summer must not be lost sight of.

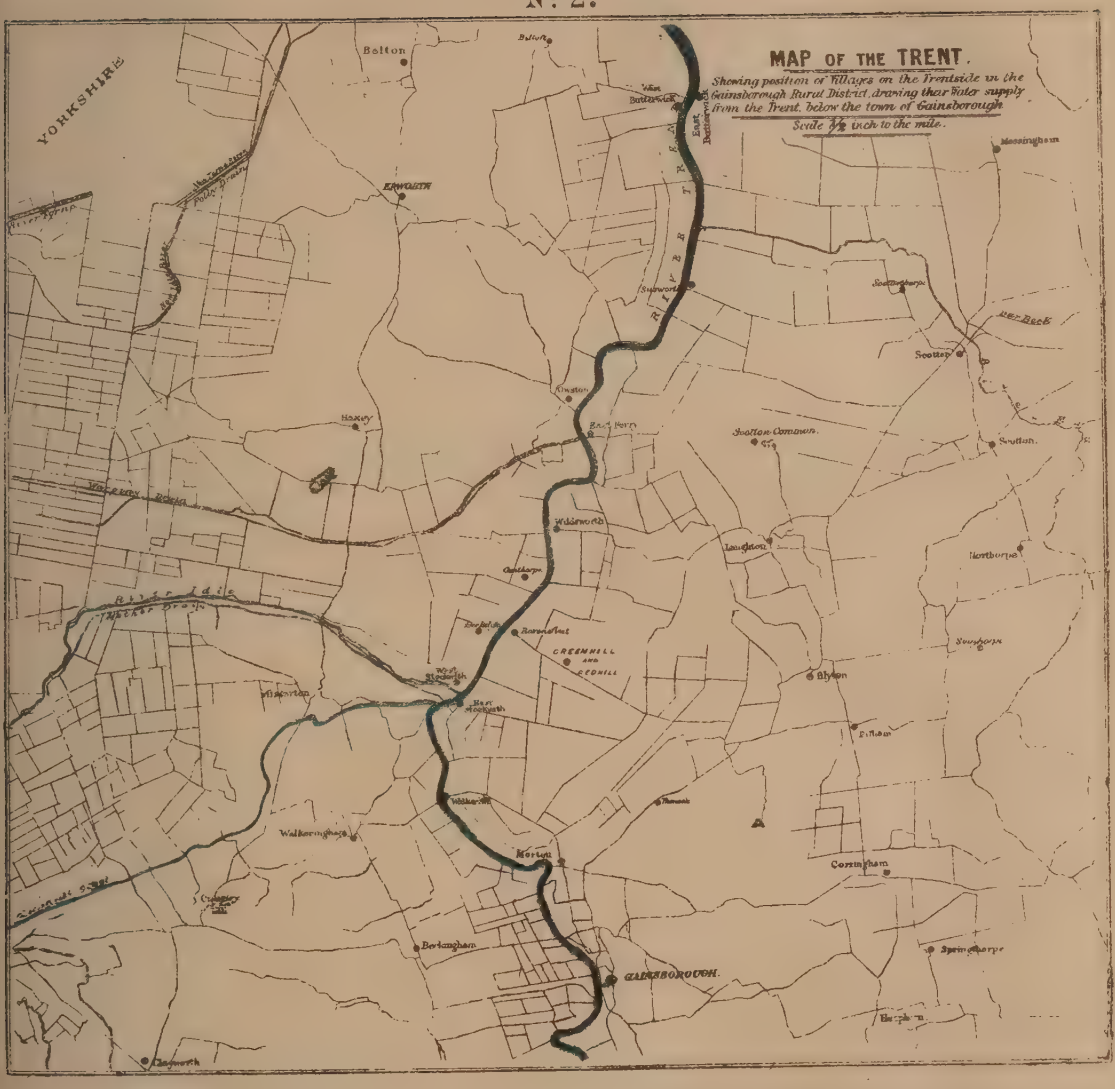
ADDENDUM.

Copies of resolutions passed at parochial meetings or committees of riverside villages with respect to improvement of water supplies, in the autumn of 1892.

West Stockwith.—Unanimously resolved that—"Having regard to the "analysis of the main supply of water being good, and that in 1891 in "a population of 730 only 11 deaths took place, six of which were over "60 years of age, showing thereby that the village is in a healthy con-"dition, and that the water supply is not dangerous to the general health "of the population; the committee do not think it necessary to take any "steps in the matter."

East Stockwith.—"That inasmuch as many of the inhabitants of East "Stockwith have an abundant supply of good well water; that no cases "of sickness have been known to arise in this parish from drinking the

No. 2.


MAP OF THE TRENT.
Showing position of Villages on the Trentside in the Gainsborough Rural District, drawing their Water supply from the Trent, below the town of Gainsborough
Scale 1/2 inch to the mile.
YORKSHIRE
Bolton
ERWOUTH
Haxey
Walkeringham
Misterton
Beckingham
GAINSBOROUGH.
Scotter
Scotton
Messingham
Blyton
Corringham
Springthorpe
Northorpe
Stow Brook
River Idle
River Trent
GREENHILL AND STONILL

No 3.

MAP OF THE TRENT.

Showing its course through the Southern portion of the Gainsborough Rural District, above the town of Gainsborough

Scale, two miles to the inch.

Wyman & Sons, Ltd., Lith., 63, Carter Lane

"Trent water; and that there has been no complaint from any of the "parishioners as to the existing supply of water for domestic purposes; "this meeting is unanimously of opinion that no steps be taken to "improve the supply."

Walkerith.—"We think there is no necessity for any further water "supply as there are four good springs of water available for domestic "purposes, and there have not been any complaints of sickness amongst "those who use Trent water, from using it. Therefore we, as a parochial "committee, do not think it is necessary to take any steps in the matter, "as our present supply is quite ample and not injurious to health."

Owston Ferry.—"That in the absence of any complaints of the water "supply, or any cases of fever occurring for a considerable period in this "village, it is undesirable at present to make any alteration in the "present mode of supplying the village with water. They also consider "that Trent water properly filtered is not injurious to the public "health."

Wildsworth.—"As nearly every house in the parish has a pump "attached to it, which yields good water for domestic purposes, there is "no necessity to take any steps towards providing any other water "supply than we have at present."

Susworth.—At a meeting of the Scotter (in which parish Susworth is situated) Parochial Committee the following decision was come to as regards Susworth:—"We find they have a good supply of wells, but the "water is not fit for drinking purposes. The general opinion expressed "is that the Trent water when filtered is far better than any other that "can be obtained within a reasonable distance."

East Ferry.—It was carried *nem. con.*, "That new wells be sunk, where "it is found to be necessary." It was also resolved "That a sanitary "main of sufficient width and size be laid down the back road, the whole "length of the village, and connexions be made from each premises "requiring drainage, the whole scheme to be under the supervision of "the parish officers, Sanitary Committee and the Sanitary Inspector of "the Gainsborough Union."

West Butterwick.—"That the Trent water is wholesome, and not "injurious to the public health, many of the inhabitants prefer the Trent "water to any other for domestic purposes. Our village is considered to "be in a healthy state, free from any disease up to the present time."

III.

ON RECENT PREVALENCE OF ENTERIC FEVER IN THE BOROUGH OF NEWARK-ON-TRENT.

The annual reports of Mr. C. Wills, the Medical Officer of Health for the Urban District of Newark-on-Trent, have, for several years, contained repeated reference to prevalence of enteric fever in that town. And recently the view has been expressed by this officer that much of the fever in the borough has been due to the public water supply. I was instructed therefore by the Local Government Board, with reference to my investigation of local water supplies in certain Trentside localities in the Gainsborough Rural District, to extend inquiry to Newark, with a view to ascertaining more particularly the circumstances under which enteric fever had been occurring there.

The ancient town of Newark, at one time a fortified place, lies in the valley of the Trent, on the banks of one of the two channels into which the river divides a mile or so above Newark. These channels reunite again a short distance below the town, and that upon which Newark stands has been artificially deepened for purposes of navigation.

The population of the borough in 1891 amounted to 14,457, and the inhabited houses numbered 3,202. The chief industries of the place are malting and brewing.

Newark stands on alluvium and gravel, overlying the New Red Sandstone. The houses in the old parts of the town are crowded closely together in narrow streets and in courts or yards which open out of them. Dwellings in the more modern parts of Newark have ample garden space. There are several rows of artisan cottages which have doors and windows only on one side.

Since the inspection of the borough in 1885 by Dr. Parsons, a considerable improvement in its sanitary condition has been effected. The direction and extent of these improvements will be gathered under the following headings :—

Sewerage.—During the last 14 years the old brick sewers have been improved, and in some cases replaced or extended by glazed and socketed pipe sewers, ventilated with grids in the roadway and in some instances by vertical shafts carried up the gables of adjoining houses. Flushing chambers, holding 800 to 1,000 gallons of waters, have been constructed at the head of most sewers. These flushing chambers are filled by a hose, and are discharged once a week. The sewers, besides receiving the rainfall, have periodically discharged into them large volumes of water from breweries and malt-houses. The sewers discharge into that branch of the Trent on the banks of which the town stands, by seven separate "drowned" outfalls. The sludge accumulating in the river near the outfalls is dredged out at intervals.

House Drainage.—In the newer parts of the town, house drains are properly constructed and sinks are disconnected. In the older parts, the house drains are often imperfect, or badly laid. Occasionally slops are conveyed along open channels with faulty gradients. The drain inlets are usually out of doors. Yard gulleys are sometimes imperfectly trapped, a favourite pattern being a shallow metal trap which is easily broken.

Excrement and Refuse Disposal.—There are some 1,250 water-closets in Newark and about 1,400 tub-closets. Midden privies are now almost banished from the town. The tub-closets are emptied weekly by a contractor. The tubs after being emptied are dusted with some disinfecting powder and replaced. House refuse is also removed once a week. In connexion with cottage property there are movable receptacles provided for refuse. In other cases there are ashpits, which are usually covered and not excavated below the level of the ground. The refuse and privy contents are carted away to a "tip" or depôt outside the town and sold to farmers as manure. At the Mount Church Schools the objectionable vault privy system is still retained. Each of the vaults in this instance measures about 15 feet long, and is sunk about 2½ to 3 feet below the level of the ground. The scavenging of the streets and market is done by the corporation's own men, the refuse being led to the contractor's depôt.

Water Supply.—Formerly Newark derived its supply from local wells of no great depth. In 1853 a company was formed to supply water to the town from culverts and wells made in the gravel close to the main channel of the Trent, about a mile from Newark. The culverts were merely tunnels constructed of brick with open joints through which the water percolated from the gravel underlying the surface. The first culvert was 340 yards in length and parallel to the Trent. In addition, three wells of different depths, varying from 12 to 36 feet, have been sunk at different dates and connected with the

MAP
Shewing Course of
RIVER TRENT
above NEWARK as
far as
NOTTINGHAM.
Scale three Miles to an Inch
NOTTINGHAM
NEWARK
RIVER TRENT

culverts; the water being pumped from the wells direct into the mains and also to a reservoir 2 miles away on Beacon Hill. On Sundays pumping being stopped, the supply is delivered by gravitation from the reservoir. Until a few years ago, whenever the Trent was flooded after heavy rains, the water overflowed the river's banks at the waterworks and reached the vicinity of the wells, causing, it is said, the town water service to become for a time muddy. To obviate this an embankment was made to prevent the floods from the Trent overflowing the waterworks. The most recently sunk well at the waterworks, which is only about 12 feet deep, was constructed by the late water company at a point only about 7 yards from the Trent. From this well a pipe was laid, "about four years ago," to the river, so that whenever the water in the culverts was low, Trent water could be admitted to the well and pumped like the other water direct to the town.

At certain seasons the maltsters and brewers require large quantities of water for their trade purposes, especially in October and November. In dry weather again, when there is much watering of the streets and flushing of the sewers to be done, larger demands are made upon the public water service. Of the total existing inhabited houses in Newark, 1,805 use the company's water, while no less than 1,547 (*i.e.*, 46 per cent. of the whole) use water from local pump wells. These wells, almost without exception, are extremely liable to pollution. Chemical analysis has condemned many of them, and their surroundings are such as to condemn most of the remainder. They vary from 8 to 30 feet in depth, and are sunk generally in the gravel upon which the town is situated.

Some three or four years ago the Corporation of Newark becoming dissatisfied with the water supplied to the town by the water company, made an attempt to buy up the undertaking. The company, however, declined to part with their works, and applied to Parliament for powers to increase their capital and to construct additional culverts to collect water. The corporation successfully opposed this application, and finally were able to arrange terms of purchase. The quality and quantity of the water afforded by the works not being satisfactory, the Town Council of Newark very wisely sought skilled assistance to advise them in procuring a better supply; and with the help of Mr. Rofe, C.E., they adopted a scheme, at some considerable cost, whereby water was obtained from a well 73 feet depth, in the New Red Sandstone at Edingly, 11 miles from Newark, and pumped to a reservoir from which the town is now supplied by gravitation. The new water was first received in the town and its use begun on July 20th of the present year. Copies of chemical analyses of samples of the new supply, made by the late Dr. Tidy, and of analyses of samples of the old supply taken at various dates are attached to this report. A map (No. 4) is also attached showing the course of the Trent from Nottingham to Newark.

Enteric Fever.

In the latter half of 1884, a considerable outbreak of enteric fever occurred in Newark, some 95 cases coming under the notice of the then Medical Officer of Health, Dr. Ashby. Of these cases 12 proved fatal. There seems also to have been during the same year an increase in the number of diarrhœa attacks, no fewer than 22 deaths from this cause having been registered during the year. It was in consequence of this

App. A. No. 9.

On the Relation of Enteric Fever, and Notes with reference to Water Supply and Enteric Fever, by Dr. Theodore Thorne.

On Recent Prevalence of Enteric Fever in the Borough of Newark-upon-Trent.

outbreak that Dr. Parsons received instructions, in 1885, to inspect the sanitary condition of the town. In his report, presented to the Local Government Board in June of that year, Dr. Parsons pointed out a number of unwholesome conditions (including possible derivation of the public water supply in part directly from the Trent), many of which might very possibly have been concerned in the fever prevalence. In his view, "the disease owned different causes in different cases," and he was not able to distinguish among a multitude of possible causes of fever, that which had had most influence in spreading the disease. By improvements effected since Dr. Parsons's visit, Newark is now in a far better sanitary condition than formerly. Nevertheless enteric fever has persisted in showing itself, year by year, in the borough. During each year, since 1874, deaths from enteric fever and from diarrhœa have been registered in the town. I have placed the numbers in the subjoined table.

TABLE I.—Showing Deaths registered year by year in Newark, from ENTERIC FEVER and from DIARRHŒA, from January 1st, 1874, to June 30th, 1893.

Deaths from	1874.	1875.	1876.	1877.	1878.	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.	1892.	First Half 1893.
Enteric fever	13	16	9	5	3	4	2	6	3	3	12	4	8	3	7	3	5	13	12	8
Diarrhœa	6	10	11	3	30	7	15	10	8	7	22	6	14	9	3	14	11	2	5	—

On January 1st, 1890, notification of infectious diseases came into force in the Urban Sanitary District of Newark-on-Trent, and since then, therefore, more precise information as to the actual amount of non-fatal fever occurring in the town has become available. The number of cases of enteric fever notified year by year in the borough since January 1st, 1890, is given in the following table:—

TABLE II.—Showing the Numbers of Notified Cases of ENTERIC FEVER and Deaths therefrom, in Newark-on-Trent during the last 3½ years from January 1st, 1890, to June 30th, 1893.

Enteric fever.	1890	1891.	1892.	First Half 1893.	Total in 3½ Years.
Cases	58	125	69*	55	297
Deaths	5	12	12	8	37

* Not including two cases notified as continued fever.

The circumstances of these 297 notified cases were investigated at one time or another by Mr. Wills, the present Medical Officer of Health, and from him I have obtained information of their distribution in each month of the year. Similarly he has supplied me with the figures, so far as they were forthcoming, for the autumn months of 1889. These data I have arranged in the following table:—

Table III.—Giving the incidence of Enteric Fever Attacks in Newark-on-Trent, Month by Month, during the last 4½ years, viz., 1889–90, 91, 92, and First Half, 1893.

—	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Totals.
1889 -	No cases heard of.						7	11	4	5	2	15	44
1890* -	1	4	1	2	3	3	3	1	1	6	20	8	53
1891 -	25	17	8	5	5	—	12	7	14	12	15	5	125
1892 -	1	1	—	5	1	3	5	12	12	7	12	10	69
1893 -	16	16	4	5	4	5	—	—	—	—	—	—	50

* Notification of infectious diseases became compulsory.

The table shows that in recent years enteric fever has tended to become epidemic each autumn, and that in alternate years the epidemicity of the autumn has extended into the early months of the next succeeding year. From the medical officer of health (Mr. Wills), I learn that the fever attacks now in question affected all parts of the town, new as well as old; that houses of well-to-do people and dwellings of the poorer class were invaded indifferently; that houses in streets where the sewers were well ventilated suffered as well as houses in streets where sewer ventilation was defective; and that dwellings served by out-of-doors tub-closets were invaded to much the same extent as dwellings provided with indoor waterclosets. Further, he had failed to trace any connexion between incidence of the fever and the distribution of one or another milk service. In the end he had come by a process of exclusion to suspect the public water supply as likely to have been concerned in the frequent recurrence in the town of the enteric fever that he had been observing, and accordingly he set to work to ascertain what had been the incidence of the fever in each year, on the consumers, respectively, of water from the public service, and water obtained from the local wells.

Seeing that consumers of well water had not in recent years exceeded 50 per cent. of the total population, the medical officer of health anticipated that if water had not been concerned in the causation of the fever, the total attacks since "notification" was adopted should be nearly equally shared by consumers of the public water supply and consumers of well water; whereas in the event of water having *actually had* concern in the fever he expected that the preponderance of fever attacks would be found among persons supplied by the public service, or among persons using well water, according as water from the one or the other scource had been the carrier of infection. The result of his inquiry in this direction was as follows:—

Of 53 persons attacked by enteric fever in 1890, 73 per cent. used the public supply.

Of 125 persons attacked by enteric fever in 1891, 91 per cent. used the public supply.

Of 69 persons attacked by enteric fever in 1892, 68 per cent. used the public supply.

Of 50 persons attacked by enteric fever in first half of 1893, 82 per cent. used the public supply.

So that of a total of 297 cases of enteric fever notified above, 78·5 per cent. occurred among that half (roughly) of the population which habitually consumed water from the public service

Results of Analyses of Samples of Water by Dr. Tidy for Borough of Newark.

(The results are stated in Grains per Imperial Gallon of 70,000 Grains, the Organic Carbon and Nitrogen in parts per 100,000.)

Description.		Total Solid Matter	Ammonia	Nitrogen as Nitrates and Nitrites = Nitric Acid	Oxygen required to Oxidise Organic Matter.	Organic Carbon.	Organic Nitrogen.	Lime CaO	Magnesia MgO.	Sulphuric Anhydride SO_3	Chlorine = Common Salt.	Hardness Before Boiling.	Hardness After Boiling.	
New Well Water.		Grs.	Grs.	Grs. Grs.	Grs.	Parts per 100,000		Grs.	Grs.	Grs.	Grs. Grs.	Degrees.	Degrees.	
1. Water at 20 ft.	New Sandy from New Red Sandstone	12·60	0·003	0·728=3·276	0	0·046	0·016	2·46	1·729	1·20	1·224=2·006	9·21	4·9	Taken 25th Oct. 1890. Each contained Silica 0·40 grs. Very slightly alkaline. Produced no odour on heating. No poisonous metals.
2. „ 68 ft.		12·40	0·008	0·728=3·276	0	0·034	0·012	2·46	1·765	1·20	1·224=2·006	9·00	4·9	
3. „ 100 ft.		11·20	0·004	0·749=3·371	0	0·022	0·012	2·24	1·657	1·27	1·224=2·006	9·51	4·5	
Present Waterworks Supply.														
1. Sample Feb. 1890		49·45	0·001	0·068..0·297	0·038	0·070	0·025	14·83	2·436	16·80	1·401=2·48	29·37	26·63	Silica 0·50 grs.
2. „ Dec. 1889		47·20	0·003	0·135=0·607	0·037	0·121	0·031	8·06	6·73	15·47	2·000=3·42	26·40	18·20	„ 0·40 „
3. „ Oct. 1890		41·60	0·004	0·135=0·607	0·045	0·168	0·045	11·20	2·45	12·20	3·828=5·782	25·93	14·84	„ 0·40 „ Clear. Total solid residue of a brownish colour.
4. „ „		40·40	0·008	0·073..0·328	0·041	0·105	0·040	10·86	2·504	12·27	3·528=5·782	24·80	14·00	Silica 0·40 grs. Turbid. Total solid residue of a brownish colour.

Dr. Tidy in his letter accompanying the Analyses of the new supply for Newark (analyses 1, 2, and 3 above):—

"I was asked confidentially for a hasty opinion. I have spoken of 2 as an 'ideal' water, the purpose was scarcely too strong. The water is absolutely free from oxidisable or organic matter, results in about 0·2 grs. of solid matter per gallon in solution and has an extra hardness of between 2 and 10 degrees.

I have also given you analyses of the water at present supplied to Newark. Two samples contained varying quantities of total solid matter ranging from 40 to nearly 50 grs. per gallon, and having a hardness varying from 24 to 30 degrees. Considering the enormous importance of a pure water supply on the health of a community, this is a terrible wound, in my opinion, for constituting a generous waiving if they failed to supply the very best water practically procurable. Compare the results of the analyses and there can be no shadow of a doubt as to what should be done. . . . .

"H. Meymott Tidy."

19th November 1890.

These facts tended to confirm Mr. Wills's suspicion that the town water supply was doing much to foster enteric fever in the borough; and having regard to the circumstance that part of this supply was on occasion being taken directly from the Trent, which river was known to be seriously polluted by the sewage of populations above Newark, the medical officer of health lost no time in urging his sanitary authority to seek elsewhere a source of supply that was altogether above suspicion. Upon this advice, the Newark Corporation, acting with commendable courage and promptitude, have carried out a scheme whereby a constant supply of pure water from the New Red Sandstone at Edingly is now being delivered to the town.

It only remains for the Sanitary Authority of Newark-on-Trent, now that they have secured this public supply of pure and wholesome water, to take steps without delay to close all polluted wells in the borough. Most of the wells in the place, as already stated, are, from their proximity to dwellings, and to privies, ashpits, pigsties, and the like, in constant danger of pollution, if indeed they are not already polluted. Hitherto active steps towards closing many of these wells could not be taken, as the Urban Sanitary Authority had not then an alternative supply of pure water to substitute for the polluted one.

August 14th, 1893.

IV.

ON THE WATER SUPPLIES OF THE THORNE RURAL SANITARY DISTRICT.

In consequence of the widespread prevalence of diphtheria and scarlet fever in the Thorne Registration District, Dr. Parsons was, in 1883, directed by the Local Government Board to visit and inspect the Rural Sanitary District. Among other matters he reported unfavourably concerning the water supplies of several places in the district, more especially of the town of Thorne. Since then correspondence has been carried on from time to time between the Local Government Board and the local authority on this subject. In the annual reports of the Medical Officer of Health reference has often been made to the unsatisfactory state of the water supply of Thorne, as well as of some other places within the district. More recently the County Council of the West Riding of Yorkshire had their attention drawn to the Thorne water supply, and their medical officer, Dr. Whitelegge, in October 1891, visited the town and reported upon its condition and on the state of its water supply. A copy of this report was forwarded to the Local Government Board for their information. Hereupon the Rural Sanitary Authority took into special consideration the question of the town's supply, and as a result instructed Messrs. Fairbank, C.E. (of Westminster and Driffield), to report on the present water supply, and to prepare a scheme for its improvement. The report of these engineers, dated June 16th, 1892, condemned the present supply, and submitted estimates for the supply of the town from a deep bore well. Upon the issue of this report a parish meeting at Thorne passed a resolution appointing a committee to confer with representatives of the Rural Sanitary Authority "on the best mode of "supplying the town with pure water." This joint committee of

parish representatives and members of the Rural Sanitary Authority next issued a report, dated November 1892, in which the old water supply of Thorne was defended, and contention made that the old supply could not be injurious to health for the reason that many persons in Thorne lived to a great age. On the question of expense and on other grounds the joint committee opposed Messrs. Fairbank's scheme, and recommended instead that the old public supply should be improved by filtration through polarite. Samples of the water, after it had been passed through polarite, were meanwhile sent by the committee to two public analysts for examination; but the reports of these analysts not proving satisfactory, the whole question remained in abeyance till May of the present year, when the annual report for 1892 of the Medical Officer of Health was received by the Local Government Board. In this report reference was again made to the fact that nothing farther had been done to improve the Thorne water supply, and attention was again drawn to the unsatisfactory condition of the water supplies of several other places in the district. The Local Government Board, after consideration of this report, decided that the whole circumstances of the different sources of water supply in the Thorne Rural Sanitary District should be investigated by the Medical Department, and as I was conducting a similar inquiry in the adjoining Rural Sanitary District of Gainsborough, I was instructed to undertake the investigation of the facts concerning the water supplies of the Thorne Rural District also.

Topography.

The Rural Sanitary District of Thorne is situated partly in the West Riding of Yorkshire and partly in North Lincolnshire. It comprises the whole of the Union of Thorne, except the Urban Sanitary District of Crowle, which, in turn, includes part of the village of Eastoft. The River Trent forms the eastern boundary of the Thorne Rural Sanitary District for a distance of some 6 or 7 miles. On the west is the Rural Sanitary District of Doncaster, and to the north and south are respectively the Rural Sanitary Districts of Goole and Gainsborough. The total area of the Thorne Rural District is 61,379 acres, of which 28,486 acres are in Yorkshire and the remainder in Lincolnshire. At the last census the population numbered 11,802, living in 2,865 houses.

Geologically, the western portion of the district is on the New Red Sandstone; elsewhere it is on the Post-Tertiary beds consisting of Warp, Peat, Sand, Strong Laminated Clay, and Gravel and Sand overlying the New Red Marl, which rises to the surface in the Isle of Axholme.

There are two towns in the district, viz., Thorne and Epworth; the latter is situated on some rising ground to the south, called the Isle of Axholme, the rest of the district being flat. Through the district the Doncaster and Keadby Canal passes eastwards from the Don to the Trent.

The main industry is agriculture, but on Thorne and Hatfield Moors the preparation of Peat Moss litter gives employment to a number of persons. Some of the parishes are sparsely populated, comprising outlying farms and small clusters of cottages.

The following table gives the names of the parishes in the Thorne Rural Districts with area, population, number of inhabited houses, and rateable value in each instance.

	Parish.	Area in Acres.	Population (1891).	Inhabited Houses (1891).	Rateable Value.
					£
Lincolnshire, Yorkshire.	Thorne	13,047	3,556	858	22,578
	Hatfield	16,159	1,686	401	14,734
	Stainforth	2,355	644	163	7,788
	Fishlake	3,329	450	121	3,457
	Sykehouse	3,596	418	107	2,901
	Wroot	3,386	333	83	2,654
	Epworth	6,151	1,903	470	6,926
	Belton	8,307	1,421	368	10,530
	Althorpe	1,352	467	93	2,232
	Keadby	1,591	592	130	4,062
	Amcotts	2,106	332	71	3,276
		61,379	11,802	2,865	81,208

General Sanitary Circumstances.

Dwelling Accommodation.—In some parishes a number of houses are unoccupied and are falling into decay. Cottages are often damp, and some dilapidated or insufficiently ventilated. Some dwellings have doors and windows on one side only. Brick floors are common. No cases of overcrowding were met with, and internally cottages are, as a rule, clean and well cared for. Except in the older parts of Thorne, there is not much crowding of houses on area. Yards are generally unpaved, and are otherwise unprotected from surface soakage.

Water Supplies.—The water supplies of the district are largely derived from surface wells. The town of Thorne and two villages partly derive their supply from the Doncaster and Keadby Canal. Two riverside villages draw a portion of their water for domestic purposes from the Trent, while one village ekes out its supply from the River Don. The inhabitants of some places store rain water in cisterns for domestic consumption; others get their supply from "dykes" or land drains. The circumstances of each parish in the district, as regards water supply, will be considered separately and in detail (*see* pages 135 to 141).

Sewerage and Drainage.—Owing to their straggling character certain villages are not sewered; slops are in such cases conveyed by house drains into adjacent ditches and land drains, or are thrown there by hand. Other villages, such as Keadby, are only partially sewered. But villages, the populations of which are more compact, are sewered with socketed pipes, the outfall of which is usually outside the village, and into some convenient "dyke" or watercourse. The town of Thorne is sewered, and the sewers are ventilated. The outfall is into the "boating dyke" which runs through the town. This dyke is said to be regularly flushed through the medium of a sluice, which, having held up the water above the town, permits its sudden release down the dyke in considerable volume. Nevertheless the dyke is said to smell offensively. Its channel is cleaned out at times by scraping the sludge from the bottom. Ultimately, the dyke discharges into the Trent below Keadby. In Thorne sinks are disconnected, but gulleys in yards have only bell-traps in many instances. Some of these bell-traps were observed to be broken. The town of Epworth is still practically unsewered. Slop water is conveyed away in open channels or gutters, often badly laid and uneven, causing formation of pools or deposit of solid matters in the street. These

channels are flushed in summer time or in dry weather by a water-cart discharging its contents at the highest point in the town, and as there is a good fall the slops are carried away into ditches at different points. The system is imperfect and antiquated, and as worked at present it is unsatisfactory. Here and there short sections of pipe sewers convey slops to an outfall in a ditch. Some houses in Epworth have no house-drains. A few houses drain to cesspools emptied at irregular intervals.

Excrement and Refuse Disposal.—There are a few waterclosets in Thorne, but the usual method of excrement disposal is by means of midden privies. The middens are often large, deep, and uncovered, consequently they are wet and offensive. Some are close to houses. There are also some old vault privies of an objectionable sort. Occasionally privies are built against the outside walls of inhabited houses, causing dampness of room-walls and unpleasant smells inside the houses. There are a few pail closets, emptied on garden land by the occupiers. At more than one school so called dry trough closets are in use. Over the excrement is sprinkled ashes, dry earth, or peat moss litter: and the contents are said to be removed at short intervals; but the plan, in my opinion, is far inferior to the ordinary pail closet. These school trough closets were often foul, wet, and generally offensive when I saw them, especially on the girls' side (owing perhaps to the fact of their containing more urine).

With regard to removal of refuse occupiers have to make their own arrangements. In Thorne a good deal of difficulty is found in getting farmers to lead away refuse during the summer months. At the suggestion of the nuisance inspector, a small sum is paid by the Sanitary Authority for emptying middens in summer, where the occupant himself is unable to remove the refuse. It is, however, very desirable that the Sanitary Authority should themselves undertake, under section 42 of the Public Health Act, 1875, the removal of privy contents, refuse, &c., in Thorne and Epworth; in the latter place, especially, I saw numerous cases where the middens and privies were in a neglected state, crammed to overflowing with filth and house refuse.

Slaughter-houses are registered. Their condition at the date of my visit was satisfactory. They are regularly inspected.

Common Lodging-houses.—There are only two in the district, one at Thorne, and one at Epworth. I found both clean and apparently well looked after.

Sanitary Administration.

The Sanitary Authority have adopted byelaws in respect of cleansing footways and pavements, for the removal of house refuse, the construction of earth closets, privies, ashpits, and cesspools; for regulating slaughter-houses; and for regulating common lodging-houses. These were allowed by the Local Government Board in 1883, as were also byelaws with respect to nuisances.

No regulations under the Cowsheds, Dairies, and Milkshops' Order of 1885 have been adopted by the Sanitary Authority. In June 1891, the Infectious Disease (Notification) Act, 1889, was adopted in the district. On the same date the Rural Authority adopted sections 4, 5, 7, 8, 9, 10, 11, 13, 14, 16, 17, and 18 of the Infectious Disease (Prevention) Act, 1890, and also all of Part III. of the Public Health Acts Amendment Act, 1890, applicable to rural districts.

Means for the isolation of early cases of infectious diseases have been provided for during the last few years by renting a block of three cottages in the parish of Belton. A caretaker and his wife reside in

the premises, and the latter is retained to act as nurse if required. Only two cases (both of small-pox) have been treated in these cottages since they were secured.

There is no proper apparatus for disinfecting clothing, bedding, &c. Fumigation by sulphur is occasionally practised, and disinfectants are supplied gratuitously to those considered unable to purchase them.

The Medical Officer of Health is Dr. H. W. Arbuckle (D.P.H. Camb.). He has a salary of 70*l.* per annum, part of which is repaid out of County funds. He makes systematic inspections of his district, and gives good advice to his Sanitary Authority, who, however, do not always act upon it. He is an able and energetic officer.

The Inspector of Nuisances is Mr. Stanley. He acts also as Surveyor and has a salary of 75*l.* per annum, part of which is repaid from County funds. He is also Canal Boat Inspector for which he receives a further sum of 10*l.* per annum. He is well acquainted with the sanitary defects of his district, and is a zealous and intelligent officer. Owing to the remoteness from Thorne, where he resides, of some of the outlying places in the district, and owing also to the fact that there is no railway service near these places, Mr. Stanley, who has to traverse the distance by walking, is unable to visit the outlying portions of his district so frequently as he should do. His salary scarcely enables him to keep a horse, without which regular inspection of such places as Wroot, Epworth, Belton, and Sykehouse cannot be easily made.

The Water Supplies.

Thorne.—(Population in 1891, 3,556.) Three-fourths of the population of the town of Thorne drink canal water, boiled or unboiled. The majority of houses have shallow wells attached to them, but the water in these is hard, and is a large proportion of cases polluted. This pollution is not to be wondered at considering the relation of many of the wells to privies, middens, and pigsties. The houses in Thorne situated to the south-west of the canal have wells the water in which is yellow (from peat), and is not for various reasons used for drinking. The water supply of Thorne is now, however, mainly derived from the canal, which skirts the whole length of the town. There are three intakes, namely: (1) near the workhouse, at the north-west end of Thorne; (2) near the middle part of the town; and (3) at the south-east end of it. Connected with each of the intakes is a rough filter bed. The filter bed at the middle intake I caused to be opened for inspection. It may be described as a covered chamber about 14 feet long and about 3 feet wide with a depth of about 5 feet. This chamber is divided into four compartments of nearly equal size which communicate with each other by means of openings in the dividing walls, and through which the water passes in succession. The compartments are: (*a*) a so-called settling tank into which the water from the canal is received; (*b*) a first filter bed filled to a depth of 3 feet with broken coke and coarse gravel; (*c*) a second filter provided with similar materials; and (*d*) the receiving tank from which the water flows by gravitation through pipes to the pumps in the town. The canal is on a higher level than most of the town. The filtering beds are cleaned out, I am informed, once in three months, when some inches of black sludge are usually removed from the settling tank. After washing, the filtering materials are replaced, but on two occasions in each year the coke and gravel are renewed. Previous to the year 1856 Thorne people drew their water in buckets direct from the canal, but in that year the

conclusion of peace after the Crimean War was celebrated by public rejoicings, and by subscriptions collected to provide a permanent memorial of the victories. This memorial took the form of the erection of public pumps to which the canal water was piped for the convenience of the inhabitants. On each of these public pumps there is a notice, now hardly legible, that "*this water is not to be used for drinking purposes at present.*" But this notice, which was posted up about two years ago, is disregarded altogether by the townsfolk.

The canal in question is fed by the waters of the River Don, which itself forms, for some miles above, a part of the navigable waterway. The Don is largely polluted by sewage and other refuse matters in its course through the Sheffield, Rotherham, and Mexboro' districts, and other populous places: it is also continually contaminated by the bowel discharges, urine, and slop water of a large floating population. On one occasion, a few years ago, the number of canal boats passing up and down through the Thorne Lock in one week was counted, and the number enumerated amounted to 500. It is not asserted that so many boats as this pass Thorne every week, but the numbers show that at times, at least, if not continuously, a considerable traffic goes through the canal past Thorne. In conversation with persons employed on the canal, I was told by bargemen and lock-keepers that two men usually are enough to work a boat, but that some masters are accompanied by their wives and children; and one master of a barge assured me that, including children, a fair average on each boat would be four persons. So that 500 boats carrying each four persons would represent 2,000 persons contributing excrement to the canal in the Thorne district at one time or another during the week. Habitual throwing into the canal from barges, of all their excrement and slops, by boatmen, was not denied. One man said they "had nowhere else to put it." In times of heavy rainfall the Don is flooded, and the water reaching the canal at and below Doncaster becomes black and smells offensively, from its greatly polluted state. On these occasions large quantities of fish are killed. At one time cargoes of nightsoil were frequently carried down the canal to the Thorne district from Sheffield. In the process of unloading, filth was commonly spilt into the water and on the banks of the canal, and after unloading, the liquid filth remaining was pumped out of the boat direct into the canal. More recently, nightsoil boats have been less frequently seen, most of this manure being now conveyed by rail from Sheffield and other towns to the rural districts.

Notwithstanding all these contaminations, freely admitted by the boatmen, they themselves use the canal water for all purposes, preferring it, like the Thorne folk, to any other.

The middle water intake (the principal one) at Thorne is situated a very short distance below a lock which has a fall of 7 feet. Every time a boat passes through this lock there is a rush of falling water stirring up the mud at the bottom of the canal, and rendering the water at the intake at times turbid. For this reason Dr. Arbuckle has recommended that, so long as the canal water is used, this intake should be above the lock instead of below it. The bed of the canal is cleaned out from time to time. Towards the Doncaster end of it, I myself saw many loads of black sludge being taken out. One lock-keeper told me he often saw the carcases of dead dogs and cats in the canal, and that he had occasionally himself to assist in taking out of the water the decomposing bodies of drowned persons.

The above facts show how the canal water is largely polluted by excrement and other matters, and that therefore under such circum-

stances the canal is not a safe source from which to take a public water supply.

In extenuation of these admitted contaminations it is urged by defenders of the present water supply that in the canal bed there are springs, and that the impurities are not only removed from the water by subsidence or destroyed by the action of sunlight, but that the more impure waters entering the canal at the higher end are greatly diluted by fresh pure water from these springs. The amount of such spring water cannot be very large, especially as the level of the canal is higher than that of the adjacent land, and can hardly materially modify the dangerous character of the canal water.

Quite recently, as has been said, a project was entertained for rendering the canal water pure by filtering it through beds of polarite. Experiments were tried on a small scale and the filtered canal water was sent for analysis to Mr. Allen, the public analyst of Sheffield. His report on it was unfavourable, and a second sample of it was sent to Mr. Angell, public analyst to the County Council of Hants. His report was not so favourable as was hoped, and the project has at present fallen through.

At the Thorne Brewery is a bore well about 240 ft. deep, yielding a supply of good water.

At Dr. Arbuckle's suggestion a 3-inch tube well was sunk at the workhouse to a depth of 104 ft. to supply the inmates. This water is regarded as pure but objection is taken to its slightly chalybeate taste; and further objection was raised against it by reason of the fact that at first the tube became clogged up with sand and other solid materials. This has now been remedied, and I am informed by Dr. Arbuckle that he is perfectly satisfied with the results.*

With regard to the scheme prepared by Messrs. Fairbank, which is mentioned at the beginning of this report, and of which a copy is appended, those opposed to it urge that the water would be hard, that it would have an iron flavour, and that though bright and clear when first brought to the surface, such water is locally known to become, on standing some hours, cloudy and opaque (from the precipitation of the iron originally held in solution in a ferrous state). These objections, however, could be removed, I am informed, by suitable filtration, or better still by the addition of lime, as in Clark's process.

The present supply of Thorne being from a polluted source it is manifestly unsafe for domestic use. Meanwhile the people of Thorne are at all times liable to outbreaks of enteric fever, and should cholera reach this country and be imported into the district, or should it occur among the canal population, a serious epidemic of this fatal disease might follow from the admixture of specific bowel discharges with the canal water. In this connexion it is worth mentioning that subsequent to the appearance of cholera in 1849 in South Yorkshire, there were I am told, upwards of 50 deaths from this malady in the town of Thorne.

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* Strata passed through in sinking this well are as follows :—

	Feet.
Top soil, clay, and warp	18
Decomposed peat	2
Blue clay	6
Small gravel	5
Sand rock	73
	104

Hatfield.—(Population in 1891, 1,686.) The water supply of this parish is from shallow wells, which are often situated in dangerous proximity to privies and other collections of filth. For instance, I noted one well, 16 feet deep, showing signs of percolation on its inside, situated only 9 feet from a double privy midden. The water in this well, I was told, became thick and muddy after heavy rains. Another well that I saw was only 15 feet distant from three privy middens and 9 feet from a wet pigstye.

Some wells are only covered by a wooden lid, which is often found broken and dilapidated. Water is got occasionally from such wells by letting down a bucket by a rope, each drawer bringing his or her own piece of rope. Complaints are sometimes made, where a well supplies a group of houses, that people are not always careful in bringing a clean pail or bucket, and that from the use of dirty vessels the water in the well is in this way polluted. The use of such wells is also attended by danger to children or to aged persons letting down the bucket, for in some cases there have been narrow escapes of the feeble water-drawer from being pulled by the weight of the filled bucket into the well. In one instance, for example, her neighbours expressed to me fears that an old woman, aged 80, would be dragged into the well in this way, or would fall in while lifting the lid. The average depth of the Hatfield wells is from 12 to 18 feet.

Stainforth.—(Population in 1891, 644.) The village of Stainforth derives its supply partly from the canal and partly from shallow wells, the average depth of which is about 16 feet. Inmates of some houses abutting on the towing-path of the canal, not only drink the canal water, but also throw their slops direct into the canal. I saw boats at this place pumping out into the canal bilge water which had been accumulating in them during their trip. Wells here are liable to pollution from soakage from deep privy pits and middens. For example, a well which was admitted to become discoloured after heavy rains had within a radius of 8 feet from it three privies with middens.

With regard to the canal some residents on its banks at Stainforth informed me that the water in long-continued dry weather "stank." They said it is always "bad" in dry seasons, such as the present spring and early summer have been. Stainforth is distant from Thorne only about 3½ miles.

Fishlake.—(Population 1891, 450.) Here the water supply is from shallow wells, from rain water stored in cisterns, or from the River Don. The surface wells are already polluted or in imminent danger of pollution. Some are admittedly so contaminated that they are only used for swilling yards. The water, I was told, was "too nasty" to be used in the house. Those who store rain-water use it for drinking purposes so long as it lasts, but when it is exhausted they take water from the Don River, as habitually do other persons who have no soft-water cisterns.

The Don, in its modern channel, locally known as the Dutch River, falls into the Ouse at Goole, about ten miles below Fishlake. The river is tidal at Fishlake, and water is, therefore, drawn from it only at low tide. The pollution of the Don has already been spoken of when referring to the canal. About two miles above Fishlake the River Don is connected with the canal by a lock at Stainforth, and boats come up the river from Hull, and *vice versâ*. The channel of the river, I am told, is becoming somewhat narrower from silt, and the amount of navigation is less than it was 20 years ago. At one time steamers plied between Stainforth, Thorne, and Hull. The water in

appearance resembles that taken from the lower Trent. It is thick and discoloured, and requires to stand some hours before it is regarded as usable. Some persons boil it, but others do not. This river cannot be regarded as at all a safe source from which to draw drinking water. It is very necessary that this river water should always be boiled before use.

Sykehouse (population in 1891, 418) is a long straggling parish extending over several miles with here and there small groups of houses. The largest of these groups is near the church. This parish has its water supply from shallow wells, many of them uncovered or only covered by a wooden lid which is often broken and dilapidated. As in other places already mentioned, these wells are often so situated as to afford every facility for their becoming polluted by soakage from privies, &c. On lifting up the lid and looking into such wells signs of percolation could be seen on the sides. The lining of these and the other wells in the district is dry steining. On inquiry I found that some of these Sykehouse wells become muddy after rain. Some wells are only 7 feet deep. One such that I saw was uncovered, and distant only 8 feet from an open midden privy. This well was about 20 yards from the churchyard and constituted the sole water supply for a row of eight cottages, two of which, however, were at the time unoccupied. The water in the well, I was told, becomes "yellow and thick after rain." The water from wells generally in Sykehouse is stated to be hard.

Wroot (population in 1891, 333) is situated about eight miles from Thorne, and lies to the extreme south of the Rural Sanitary District. There is a public pump-well in the village, stated to be 22 feet deep. It was sunk about six years ago. The well inside, for a depth of 13 feet, is lined by bricks laid in cement. Its situation is suitable, and it is sufficiently far removed from any privies or middens to be fairly free from danger of pollution. It is said to yield a good supply of pure water. Many houses in Wroot, however, have private wells, and some of these from their position are liable to contamination. The average depth of these private wells is about 18 feet.

Epworth.—(Population in 1891, 1,903.) This is a small market town, the number of whose inhabitants is gradually decreasing. Since the census of 1881 the population has diminished by 290. The town consists of a long straggling street, nearly two miles in length, stretching from the market place at the higher part of the town to the flat country to the west. There are many wells in Epworth; those in the lower part of the town, to the west especially, are seldom used for drinking purposes, the water being very hard and sometimes discoloured. Very generally rain-water is used instead. Large cemented brick cisterns are constructed underground and contain a considerable quantity of rain water when filled. In times of long continued drought, I was informed, some persons have to fetch their supply in water carts from the River Torne, two miles distant. The Torne is a small tributary of the Trent, which it joins near the village of Althorpe. The local wells are often situated close to the foldyards, from which soakage into the well must often take place. Even rain-water cisterns underground are sometimes liable to pollution from their proximity to filthy accumulations, when their cement lining cracks and peels off. There are two public wells in Epworth sunk in the rock towards the higher part of the town, their depth being about 30 feet. The water from them is

largely used for flushing the open channels or gutters already referred to. It is possible, I am told, when much water is taken for flushing purposes, to pump these public wells dry.

Belton (population in 1891, 1,421) is a sparsely populated parish, comprising seven or more hamlets along with scattered farm-houses. There is no considerable aggregation of houses at any one place. The water supply is derived from shallow wells of the sort so often referred to in this report, and these have the faults which have already been indicated. Occasionally water is taken from one or other of the numerous "dykes" which pass through this parish conveying land drainage to the Trent. Into some of these "dykes" farm-houses, foldyards, &c., drain. At North Moor, for example, one family till lately derived their only water supply from a dammed-up ditch into which, higher up, the drainage of a mansion provided with water closets discharged. Quite recently the owner of the property, through the representations of the officers of the Sanitary Authority, sank a tube-well to the depth of about 150 feet, and from this a plentiful supply of wholesome water is now obtained, though it has a somewhat chalybeate taste.

Althorpe (population in 1891, 467) is a Trentside village, and draws part of its water supply from the river. Water is drawn from the Trent in buckets, but only at low water, just before the tide begins to flow again.* Most persons boil the river water before use. Althorpe is only about two miles lower down the Trent than West Butterwick, a village in the Rural Sanitary District of Gainsborough, in the report on the water supplies of which district information as to the pollution of the lower Trent will be found. At Althorpe there are also wells in use. Many of these have objectionable surroundings, as elsewhere in the district. Several wells are about 25 yards from the somewhat crowded churchyard, interments in which have been or are just about to be discontinued. A few persons drink water taken from the New Torne River, a large drain which extends from the Doncaster district to the Trent, draining a large area of flat country. This water, though exposed to washings from heavily manured fields, is, perhaps, less objectionable than that from the Trent.

Keadby (population in 1891, 592). This is a Trentside village, situated at the point where the Keadby and Doncaster Canal effects a junction with the river. The canal basin has in it, nearly at all times, a considerable number of barges, waiting for cargoes of coal. The coal is brought from the South Yorkshire coal-fields by train, and is shipped on board barges at Keadby for Hull and elsewhere. Many Keadby people find work in connexion with the working and loading of the boats. The village itself consists of a long street of houses facing the Trent. Keadby is a little over a mile below Althorpe. The water supply of the upper end of Keadby is taken from the canal. Into the canal basin is cast the excrement and slops from the boats lying there. (I counted 50 boats in the basin on the day of my visit.) The boatmen also draw their water supply from the canal. Reference has already been made earlier in this report, when describing the water supply of the town of Thorne, to the opportunities which the canal has of becoming contaminated. In the central part of Keadby, some persons store rain-water, as elsewhere, in underground brick cisterns. There is

* The water is brackish at high tide.

a large underground cistern for collection of rain-water from the roof of a Temperance Hall, and this water, I am told, the caretaker sells to applicants, at the rate of four pailfuls for a penny. There are some shallow wells, too, in Keadby, unprotected from soakage of filthy matters. Water from one such well was said "to stink," and to become thick and discoloured after rain: the people said they preferred to drink the canal water. These wells are about 20 feet deep. At the lowest end of the village, the people have no other supply than that they draw out of the Trent at low water, just at the turn of the tide. The water in the river here is at other times brackish. At spring tides, owing to the "Eygre," or tidal wave, they are unable to get good water, and have to lay in a stock beforehand at low neap tides. Keadby is only about eight miles from the Humber. The Trent water when drawn from the river is allowed to stand for some time to allow the copious sediment to settle. Most persons boil it before use, but some do not. Near the lower end of Keadby is a yard containing 15 houses. These have no wells or underground rain-water cisterns, and their supply for all purposes is from the river.

Amcotts (population in 1891, 332) is also a Trentside village, situated about two miles below Keadby. At this village I am assured no river water is used at all; and indeed there would, ordinarily, be great difficulty in drawing water from the Trent here at low water, since the water in the river cannot be reached without first crossing soft mud banks. The water supply of Amcotts is from shallow wells supplemented by rain-water collected from the house roofs. The wells here are liable to contamination from percolation of fluid filth from deep privy middens and pigsties. Some of these wells have no pumps, and are in no way covered in; others have only a wooden lid. The water in them in some cases changes colour after rain, becoming yellow and leaving a sediment. Some of the wells are only 12 feet deep. Rain-water cisterns, too, are liable to similar pollutions when the cement inside cracks or shells off.

General Summary as to Water Supply.—The water supplies of the Thorne Rural District, as will appear from the foregoing account of them, are, generally speaking, of an unsatisfactory character. Water drawn from the canal or from the rivers would seem especially dangerous; not only by reason of the known pollutions which have access to them, but also because the Sanitary Authority can have no power to prevent the pollution of these waterways by strangers suffering from communicable disease. Under these circumstances the Sanitary Authority should disregard the protests of those who are not alive to the dangers arising from the use of contaminated water, and proceed at once with measures to obtain safer supplies, beginning with a scheme for the town of Thorne, the largest centre of population in the district.

Meanwhile, as previously stated, the best security to be had is obtainable by boiling all water used for drinking purposes.

With regard to local wells, their condition, pending the obtaining of better supplies, might be materially improved by protecting them against contamination. To this end the removal of all privies, pigsties, and middens to a safe distance from the vicinity of the wells is called for. All privy pits and middens which are below the level of the ground should be abolished, and in substitution for them a pail or tub system should be used. The closets should be furnished with an impervious floor, the receptacles should be frequently and regularly emptied, and their contents should be properly disposed of.

If it be contended that no great mortality attributable to the use of impure water has arisen in the district in recent years, the answer is that the water supply has every facility for becoming specifically contaminated by the bowel discharges of infected persons, and that therefore disaster may occur at any time on a scale of considerable magnitude. Belief in the security of Thorne from epidemics of enteric fever, choleraic diarrhœa, or cholera, does not rest indeed upon any true basis. Having regard to the frequent daily communication which Thorne has with Hull by means of the Trent, the canal, and by rail, it is obvious that if cholera were introduced from abroad into the Humber ports, the disease has plenty of chances of quickly reaching the Thorne district and spreading itself there. Apart from this danger, there is the ever-present one of enteric fever being introduced to the canal from Sheffield or elsewhere, either by reason of the sick-bed cradle or by persons who live on board boats and whose discharges might infect hundreds unconsciously drinking the specifically contaminated water.

The map (No. 5) opposite shows the course of the Trent in the Thorne Rural Sanitary District. The position of the privies throughout the whole district can be seen on the large map at the end of the Rivers' report on the River Trent.

MAP

showing the lower part of the Course of the

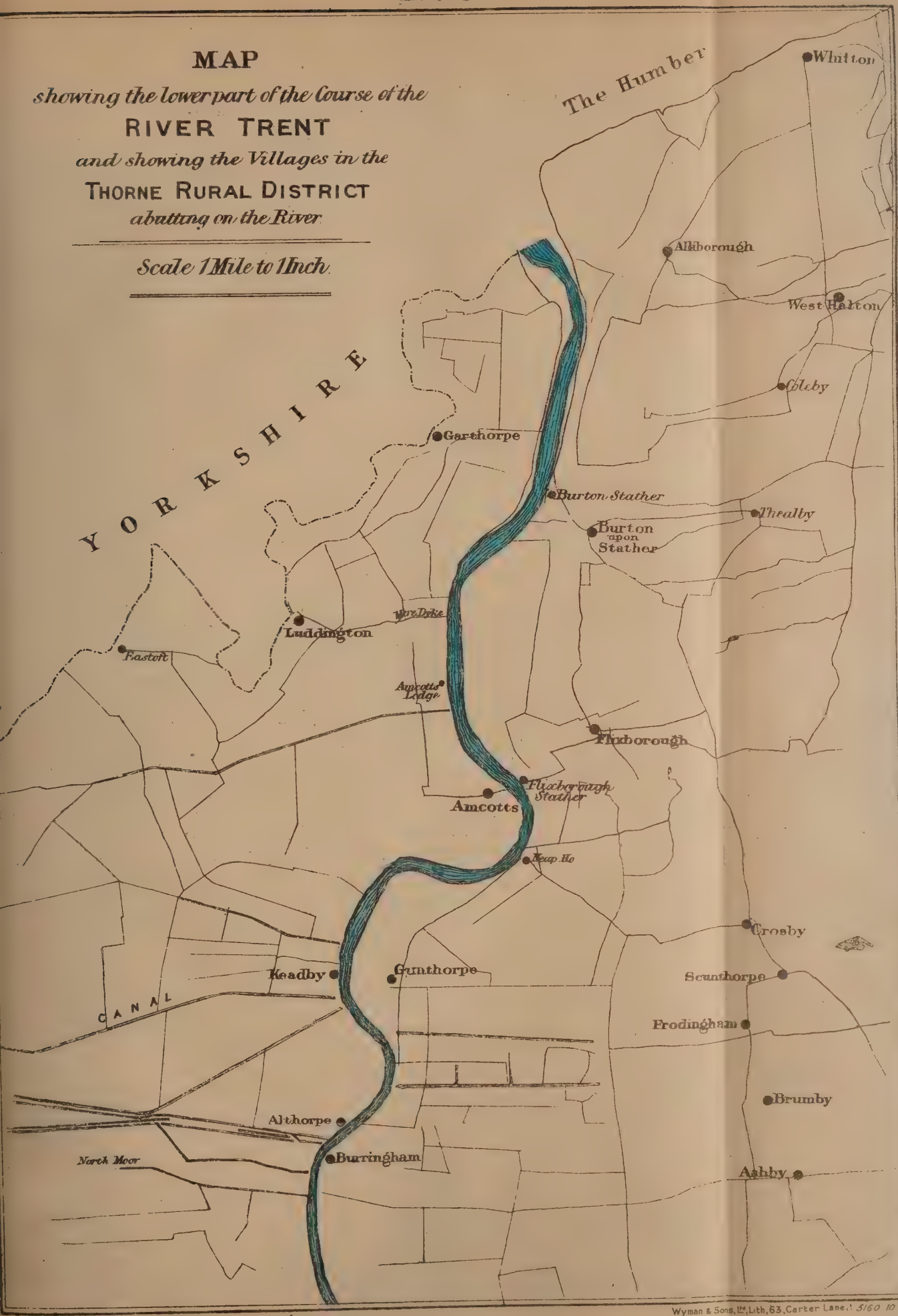
RIVER TRENT

and showing the Villages in the

THORNE RURAL DISTRICT

abutting on the River

Scale 1 Mile to 1 Inch.



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No. 10.

Report on an outbreak of Diphtheria in the Hinckley Urban and Rural Sanitary Districts; by Dr. S. W. Wheaton.

It having come to the knowledge of the Local Government Board, through the Quarterly Return of the Registrar General, that an epidemic of diphtheria had broken out in the Hinckley Urban and Rural Sanitary Districts, which had caused 10 deaths during the third quarter of 1893, I was instructed to make an inquiry into the circumstances with which the disease was associated.

I. Hinckley Urban Sanitary District.

(*a.*) *General Sanitary Condition of the Hinckley Urban Sanitary District.*

The district under the control of the Hinckley Urban Sanitary Authority comprises the town of Hinckley with a few outlying houses. The district has an area of 3,729 acres, and had in 1891 a population of 9,638 persons living in 2,032 houses. The population has increased rapidly of late years; in 1881 it consisted of 7,693 persons only, living in 1,681 houses. At the present time the population is estimated at 10,000 persons.

The inhabitants are chiefly engaged in the stocking and boot manufactures, and there is a large proportion of young adults of both sexes who go to work in the factories, of which there are many in the town.

The town is situated at the southern extremity of a spur of hills forming part of the watershed between the Rivers Anker and Soar. Nearly the whole of the town is situated at an altitude of more than 400 feet above Ordnance datum, and the greater part of it is built on ground sloping to the south-west, towards the River Anker, which is about four miles distant. The subsoil consists of a stiff clay, in most places of great depth, with occasional beds of sand. The ground, therefore, is cold and retentive of moisture. Owing to its high elevation above the surrounding country, which is almost level, the town is much exposed to bleak winds from all quarters; and it is subject to fogs and mists, which, I am told, frequently accompany winds blowing from the south-west. There are four main streets converging to the centre of the town, which, with the exception of Castle Street, are fairly wide and open; the space between these main streets is filled up by a collection of courts and short streets, and by houses grouped irregularly, so as to impede lighting and ventilation. In the outskirts of the town, however, where a good deal of building has taken place of late years, there are a number of streets the houses of which are well built, and provided with sufficient open space both in front and at the rear.

Water Supply.—This is derived from a deep well situated near the village of Snarston, 14 miles distant. The well is said to communicate with some disused colliery workings. The water is pumped into an iron pipe, which conveys it to the town, where it is collected in two reservoirs, a high level and a low level one, from which it is distributed by gravitation. Nearly all the houses in the town are supplied with this water, which appears to be of excellent quality as well as abundant. A very few households still use wells, and in one instance I found that rain water was being used for drinking purposes.

Isolation Provision.—The Authority has not made any hospital provision for the accommodation of persons suffering from infectious diseases.

Disinfection.—The Authority possesses no disinfecting apparatus; nor is the disinfection and fumigation of infected houses carried out by the Sanitary Authority.

The Infectious Disease (Notification) Act, 1889, has not been adopted.

Sewerage.—The present Inspector of Nuisances, Mr. W. T. Howse, who combines this duty with that of Surveyor to the Authority, having only been appointed for a few weeks, and being a stranger to the town, was not able to give me much information with regard to the sewerage of the place. Mr. Howse, however, rendered me every assistance that was in his power, and the sewers were opened for my inspection at various points in the town. The Authority possesses no reliable map of the sewers, and this rendered the investigation more difficult. The sewerage of the town was commenced in 1883; but no regular plan appears to have been followed, and some of the old highway drains and culverts still remain, and are connected with the sewers which have been more recently constructed. Since it is situated mainly on the slope of a hill, the town is well placed for sewerage. There are two main sewers, composed of sanitary pipes, which collect the sewage from the northern and southern portions of the town, and which join, at different points, an outfall sewer, by which the sewage is carried on to the sewage farm, which is about a mile to the south-west of the town. The outfall sewer commences in Rugby Road at the south-western end of the town, where it is joined by the northern main sewer, and by a sewer passing down Coventry Road. The outfall sewer passes down the Rugby Road, and at the junction of Rugby Road and New Road is joined by the southern main sewer, after which it passes straight across fields to the sewage farm. The mouth of the outfall sewer is not provided with any flap to prevent the wind from blowing up it. There is an arrangement by which, if the level of the sewage in this sewer rises above a certain height, it overflows directly into the Sketchley Brook. At the time of my visit some of the sewage was overflowing in this way. At the farm the sewage passes through a trough containing lumps of a preparation of alum, and then into a depositing tank, from which it runs into a carrier conveying it on to the farm land, which is about 170 acres in extent, and on which the sewage is distributed by "broad irrigation." The land of the sewage farm is partly arable, partly permanent pasture. The effluent from the sewage farm escapes into the Sketchley Brook, which joins the River Anker. At the time of my visit the effluent was not clear, and contained a large amount of flocculent matter in suspension, but it had no offensive odour.

Of the two main sewers, that which collects the sewage from the southern portion of the town commences in Burbage Road, at which point it receives the sewage from the workhouse; it then runs almost parallel to the railway, passing across several fields, and receiving several branch sewers from streets at right angles to its course. It finally passes across Station Road and down New Road, at the junction of which with Rugby Road, as just mentioned, it joins the outfall sewer.

From the manhole at the upper end of this southern main sewer in the Burbage Road a most offensive fæcal odour was emitted at the date of my visit, and the sewer at this point was found to contain a large amount of liquid filth. At a point about 200 yards further down in its

course this sewer is joined by a branch sewer passing down the Queen's Road; and at the junction with this branch sewer there is a manhole from which a very offensive smell was also emitted. On examining the main sewer at this point it was found to contain a deposit of offensive filth six inches in depth. There could be no doubt indeed that this sewer, between its commencement in the Burbage Road and the point at which it is joined by the Queen's Road branch sewer, contained a large deposit of decomposing fœcal material. At this end of the town there are a number of streets of newly-built houses, which are furnished with water-closets, the contents of which would be discharged into this portion of the main sewer.

On examining this main sewer at a point about 150 yards below that at which it is joined by the branch sewer from Queen's Road, it was found that a very small stream of liquid was passing down it as compared with that flowing in at the point where the Queen's Road sewer entered. It was evident, therefore, that there was some defect in the sewer between the two last-mentioned points; but owing to its depth below the surface its further examination was postponed for the time being.

Still lower down in its course, and a short distance above the point where it joins the outfall sewer in the Derby Road, this southern main sewer has been carried through a bed of loose sand, and the ground having subsided here in the line of the sewer a large hole was dug in order to examine into its condition. As the result of this examination it was found that the sewer was broken at this point; that some of the pipes composing it, which were 1 ft. 3 ins. in diameter, had disappeared; and that the ground in its neighbourhood was saturated with liquid sewage and had become swampy in consequence.

The northern main sewer was next examined, and the larger branch sewers which join it. This main sewer commences in the middle of the town, in an open space called the "Borough" close to the Market Place, and it is formed by the convergence of a very long branch sewer passing down Bond Street, and branch sewers passing down Mansion Street and Stockwell Head respectively. The Bond Street branch sewer was opened for my inspection at one point, and a number of the pipes composing it were found to be split in half longitudinally, allowing of soakage of sewage into the surrounding ground. The branch sewer in Mansion Street was found to be an old brick drain, coated in its interior with filthy slime; and evidently it allowed a large amount of soakage into the surrounding soil, since on a fine day it was almost completely dry. This brick drain receives sewage from a large number of houses, and from a large court. The branch sewer passing down Stockwell Head appeared to be in good condition, and is composed of sanitary pipes; but it had an old brick sewer opening into it, which collects the sewage from the street known as New Buildings.

On following the northern main sewer downwards from its commencement in the "Borough," the first branch sewer which joins it is one passing down Castle Street, the main street of the town, and joining the main sewer in the Market Place. This Castle Street sewer was found to be an old brick culvert, containing a good deal of slimy filth, and allowing of soakage into the surrounding ground, owing to the mortar between the bricks of which it is composed having "perished." In the Market Place, too, the main sewer is joined by a branch sewer passing down Church Walk; and this sewer was likewise found to be an old brick drain, the sewage in which evidently escaped into the surrounding ground, the mortar between the bricks having disappeared.

Art. 4. Notes on Epidemics in Hanover Ward and Inspection of the Sewers.

From the Market Place the northern main sewer passes down Regent Street and Derby Road, where it joins the outfall sewer as before mentioned. In this lower part of its course this main sewer appeared to be in good condition. The branch sewer joining it hereabouts from a short street known as Cork Hole was, however, less satisfactory. The manholes connected with the branch sewer in this street emitted a foul stench, and the inspection chamber was found to be nearly full of offensive filth.

There is another and less important main sewer which has not yet been described. This sewer passes along Coventry Road to join the outfall sewer in the Derby Road. It is composed of sanitary pipes, but was found to contain a large amount of filth at several points, one inspection chamber being nearly half full of filth. At one point this sewer contained a deposit of a fat-like material, which is said to be washed into it from the stocking factories. Hot water from factories is discharged into the sewers at various points, and, so far as I could learn, no attempt is made to cool this water before turning it into the sewer. Between the street known as New Buildings and the Board Schools is a foul watercourse, receiving the sewage from a number of houses, and filth from privies and ashpits on its banks; this watercourse discharges into a sewer.

The sewers are ventilated by a few surface gratings in the streets, but there have been many complaints of effluvia arising from them, and some of them have been stopped up in consequence. No provision exists for flushing the sewers. The street gulleys are connected with the sewers and are in most instances untrapped.

House Drainage.—Most of the house drains are provided with properly trapped gulleys in the case of the newer property, but the drains in the older class of property are either untrapped or fitted with the old-fashioned bell trap. The house drains of the newer houses are in good order, but as regards the older houses they are very defective, being, in in some instances, composed of brick or stone and passing commonly under the houses. Many instances were brought to my notice where the old house drains had been found to be stopped up, or to be so defective as to allow of soakage into the surrounding ground. Very few houses have indoor sinks, except as regards the newer class dwellings, in which case the sink pipe is properly disconnected and made to discharge over a gulley in the open air.

Excrement disposal is effected principally by means of privy middens. The houses which have been built recently are provided with pail closets, or water-closets in many instances, but some are still being erected which are furnished with midden privies only. The privy middens are of the most objectionable kind, being sunk below the ground level, uncemented, uncovered, and often of large size. Many were met with which contained a large amount of liquid filth, and in some cases manure from stables or from pigs had been thrown into them. Often, too, the privy middens were overfull, and filth was soaking through their walls, or escaping on to the surrounding ground. In several cases they were situated so that the wall of the dwelling-house formed one of their sides, and some were placed beneath windows or close to the doors of houses. They are in nearly all instances situated too close to houses. Insufficient privy accommodation was noticed in some instances, one privy not infrequently serving for a whole court of 6, 10, or 12 households. The pails, in the case of pail closets, are of galvanized iron, and a separate pail is provided for ashes. The water-closets in the town are provided with separate flush-out cisterns. Scavenging is performed by the Sanitary Authority. The pail closets are emptied once a week, but the

privy middens are not emptied at regular intervals; and not until they are overflowing in most instances. The material removed is carried to the sewage farm, from which it is carted away by farmers as they require it.

House Accommodation.—A great number of the houses in the town are old and dilapidated, and in many instances they have brick floors; but on the outskirts of the town there are a large number of houses recently built or in course of erection, which are well built in every way. There are many courts in the town. These latter are as a rule square, with narrow entries; the houses in them are generally very dilapidated, often without eave spouting, and with defective roofs and crumbling walls. There are also a few old thatched cottages still remaining in these courts. The ground around the houses in the courts, and in the older streets of the town, is very uneven, and either unpaved or laid with cobbles; pools of stagnant water lie around the houses, and the presence of overflowing privy middens and defective house drains adds to the general filthiness of the surface of the ground. The yards in the newer houses are in most instances paved with bricks, but often these are unevenly laid. In consequence of the before-named defects and the clayey character of the subsoil, the ground around houses in Hinckley is almost everywhere very damp. This dampness is much increased by the custom of constructing leaky rain-water cisterns below the ground level close to the houses, or in cellars under the houses. These rain-water cisterns often have an overflow pipe communicating with the sewer. The cisterns are composed of bricks, and, even when lined with a thin layer of cement, this is often found to be cracked; so that in some cases the filth from privy middens sunk below the ground level obtains entry into the cistern.

Nuisances Arising from the Keeping of Animals.—In some instances pigs and fowls were found to be kept in proximity to dwellings, and in such manner as to give rise to nuisance. In one instance fowls and rabbits were found established in a cellar adjoining a house in which diphtheria was present. As a rule, however, nuisances arising from the keeping of animals are not common in the town.

Slaughter-houses.—The slaughter-houses in the town are not registered, and do not appear to be supervised in any way; in several instances they were dirty and dilapidated, with defective flooring and without drainage. Accumulations of offal in the neighbourhood of slaughter-houses, in privy middens, or on manure heaps, were noticed in several instances.

Cowsheds and Dairies and Milk Shops.—With regard to these there is no register kept, and there does not appear to be any supervision of them by the Sanitary Authority. I only observed one cowshed in the town, the condition of which was very filthy; but there are a number of milk shops at which milk, brought in from the surrounding country, is sold. In several of these milk shops the milk was kept in living rooms, in others in cellars under the houses, where it was often exposed to contamination in various ways.

At one milk shop, where the milk was kept in the cellar, a case of diphtheria had occurred, but the sale of the milk had not been stopped during the person's illness.

Bakehouses.—These are, in some instances, old dilapidated buildings. In the case of one bakehouse, which was situated below the ground level, a large privy pit, also sunk below the ground level, was only 3 ft. distant. In several instances privies were found abutting upon bakehouses.

Common Lodging-houses. — There is no register of these kept Those that I inspected were old houses, but fairly clean; the privy accommodation was in each instance very defective.

From the foregoing account it will be seen that the soil of the town of Hinckley is naturally damp, and that the sites of houses are rendered especially damp by the defective paving of yards and by the presence of leaky underground rain-water tanks in the neighbourhood of, or actually under, the houses. In the older houses this dampness is also increased by the absence of a "damp course," absence of eave spouting, absence of proper flooring in some instances, and by the presence of stagnant water in their neighbourhood. The ground in the neighbourhood of houses besides being damp, is, moreover, saturated with filth, and this applies not only to the older houses, but to many of the newer ones also, owing to the presence of midden privies, sunk below the ground level, allowing filth to soak into the soil. In addition, in many instances filth overflows on to the surface from these privies, and is washed into the ground, owing to the defective paving. In many instances, also, the house drains are in such a condition as to allow soakage of their contents into the ground, and many of the sewers similarly allow of soakage into the surrounding soil. In the case of the newer houses, on the outskirts of the town, however, contamination of the ground by filth from privies and defective drains does not occur, owing to their being provided with pail closets or with water-closets, and with efficient drains.

(*b.*) *Prevalence of Diphtheria in the Hinckley Urban Sanitary District.*

It is noteworthy that no death from diphtheria was registered in this district during the year 1892; and that no cases of this disease came under the notice of the Medical Officer of Health. One death only was returned as being due to croup. Nevertheless, in the latter half of the year there was an extensive prevalence of measles in the district, complicated by throat affection. No less than 84 cases of measles came under the notice of the Medical Officer of Health, and 24 of them proved fatal. Reporting upon this outbreak of measles, the Medical Officer of Health notes that "the chief cause of the mortality seemed to "be a septic exudation on the fauces and throat, which in young "children, owing to the difficulty in applying local applications and in "feeding them, induced exhaustion." He further says that "with "regard to this complication, it did not appear to depend upon any "local sanitary defect, as it attacked children in various parts of the "town, and was as severe in the modern dwellings as in the old." On conferring with the Medical Officer of Health, he informed me that he regarded the septic exudation on the fauces and throat as being of the nature of diphtheria. No instance of paralytic symptoms or of albuminuria following this condition came under his observation; and I could not find that any such sequel had been observed by any of the medical practitioners in the town. With regard to the 24 deaths occurring from measles during 1892, six were under one year of age, 13 under two years, and five under three years; so that all the deaths occurred in children under the age of three years. During the last quarter of the year 1892, scarlet fever of a mild type became also prevalent in the town, no less than 176 cases coming to the notice of the Medical Officer of Health; and two deaths were registered in this year as being due to this disease. Throat complications, however, were not a notable feature in the scarlet fever which was prevalent in the last

quarter of 1892, a fact which is borne out by the low fatality of the disease in that year. Scarlet fever continued to prevail in the spring of 1893; and up to August 13th, four deaths were returned as due to "scarlet fever." In addition to these four deaths, one death in March was registered as being due to "scarlet fever" and Cynanche tonsillaris, and two in May as being due to "scarlet fever," accompanied by malignant sore throat in one case, and laryngitis in the other. On October the 2nd, and also on November 28th, a death was registered as being due to "scarlet fever and diphtheria." It will thus be seen that, although, as I am informed by the medical men in the town, the epidemic of scarlet fever has declined in 1893 as compared with 1892, yet the mortality from this disease has been increased, in 1893, by the prevalence of throat complications.

The first death which was registered as being due primarily to diphtheria in 1893 occurred in February; no further deaths from this disease were registered until September 14th, after which date there was a rapid succession of deaths from diphtheria; four deaths from this cause being registered in September, eight in October, and thirteen in November. In addition, a death from Cynanche gangrenosa and a death from membranous croup, were registered in the month of July; on inquiry of the medical men who attended these cases, and after personal inquiry also, I found that both of them were undoubted cases of diphtheria. So that up to November 30th, 28 deaths from diphtheria have occurred in Hinckley in 1893. At the date at which I commenced inquiry (November 24th) it was evident that a very serious epidemic of diphtheria was in progress in the town. One medical man had already attended over 100 cases; another had attended 52 cases; and it became evident that between 200 and 300 cases had occurred. Having been furnished with lists of cases from the medical practitioners in the town, I made a personal inquiry into 76 cases of diphtheria, eight cases of scarlet fever complicated by diphtheria, and several cases of sore throat or other disease, the exact nature of which was more or less doubtful. In many instances I was accompanied by the Medical Officer of Health, Mr. W. H. Griffiths, who rendered me every assistance that he could, although very heavy demands were being made upon his time in consequence of the epidemic. I found that the diphtheria was, for the most part, mild in type;* that it was entirely confined to the households of the working classes; and that the disease was not limited to any part of the town, the invaded households being scattered more or less all over it.

With regard to the age incidence of the disease, out of 68 cases in which the age of the patients was ascertained, 39, or 57 per cent., were under five years of age; 22, or 32 per cent., from five to 14 years of age; and only 7, or 10 per cent., above the age of 14 years. With respect to the age incidence of deaths from diphtheria, of the 28 deaths 22, or 78 per cent., occurred below the age of five years; and the remaining 6, or 21 per cent., were over five and under eight years of age. No death had occurred above the age of eight years up to the time at which I commenced my inquiry, but I heard subsequently of

* I only met with two instances in which distinct paralytic affections followed the diphtheria attack; but this may be to some extent explained by the fact that sufficient time had not elapsed for the development of paralytic symptoms in many of the cases which had been attacked up to the time at which the inquiry was begun. It is well known that paralysis, except temporary paralysis of the soft palate, does not, in many instances, ensue for weeks, or even for months, after the primary disease.

the death of a child, who was a "half-timer" at the Board School, at the age of 14 years.

As to the *origin* of the outbreak of diphtheria in Hinckley:—In the first place there were no circumstances which cast any suspicion upon the water supply as the source of infection. All the invaded households were using the public supply, there were no cisterns in these houses, so that the water could not have become contaminated by storage in this way; and the disease was confined, as has been said, to the working classes, although all classes equally consumed the town water. Milk, too, as a possible cause of the disease, had to be dismissed from consideration. In many instances no milk was consumed at all, or at most was only taken with tea or coffee. Out of 46 households in which the source of milk supply was ascertained, it was found to be obtained from 14 different milk sellers; the greatest number of households obtaining milk from any one source being 17 and 5 respectively. Moreover, had the outbreak been due to infection through milk it should not have been limited to the working class households, but should have invaded also the households of the tradespeople and gentry, who, if anything, were greater consumers of milk than the other class. No information of any disease among cows at the dairies in the surrounding country district from which the milk is supplied, could be obtained; and these dairies appear to be, for the most part, clean and well ordered. At the same time the conditions under which the milk was kept for sale at the milk shops in the town were very far from perfect, and in at least one instance milk had been sold which was stored in the cellar of an infected household. No history of affections resembling diphtheria among fowls, cats, dogs, or other animals could be obtained.

With regard to emanations from the sewers and drains as a cause of the outbreak, or as a medium of infection: it was in the first place found—and careful inquiry was made as to this point—that in only three invaded households did an untrapped drain terminate inside the house. In all other instances the drains terminated outside the houses, often at a considerable distance from the dwelling. And secondly, with regard to the condition of the house drains, although these were in some instances very defective, still in the majority of houses in which diphtheria had appeared, the house drains were in good condition and efficiently trapped. It was also noticeable that the disease was not especially prevalent in localities the house drains of which communicated with those sewers which were in an especially defective condition, and which, as in the instance of the southern main sewer between Queen's Road and Burbage Road, contained especially large deposits of filth. With respect to the possible influence of exposure to the emanations from the sewers, which emanations undoubtedly were given forth in large quantity during the months of August and September from the street ventilators and gulleys, I did not find any instances where such emanations were likely to obtain entry directly into houses; and the houses in the neighbourhood of the open gratings ventilating the sewers were not especially invaded. It was also noticeable that the drains from the workhouse communicated with the southern main sewer at its upper end. These drains were also defective, requiring flushing, and having a privy vault emptying into them, which caused a deposit of filth; nevertheless there occurred no case of diphtheria in the workhouse, although there were 13 children under the age of 15, and 87 adult persons in the building.

In view of these considerations, therefore, I infer that sewer emanations did not act in Hinckley, either as the cause of the diphtheria or as the vehicle by which the infection was conveyed.

As to the influence of accumulations of excrement in privy middens:—It was found that middens were in use in 36 out of 48 invaded households with regard to which particulars as to excrement disposal were obtained; five of the remaining 12 houses being furnished with water-closets and seven with pail closets. These numbers, as far as I could judge, fairly represent the proportions in which the three methods of excrement disposal are in use in the households in the town; so that there would appear to have been no special proclivity of houses using privy middens to invasion by disease. The invaded households were scattered over the town, and there was no localization of the disease to any particular courts or groups of houses the inhabitants of which had the use of particular privies in common. In many instances a case of diphtheria would arise in a small court or in a group of houses, and the excreta and other possibly infectious matters from the patient would be thrown into the midden privy without any disinfection; and notwithstanding that the privy was used in common by the inhabitants of the court or group of houses, no further cases of the disease arose in that locality subsequently.

For these reasons, therefore, it would appear that the midden privies, although their condition was so defective and filthy, were not directly concerned in originating or in spreading diphtheria. Nevertheless it appears to me by no means certain that these privies had not to do with the special incidence and fatality of the disease among children below the age of five years. Children at this age do not go away from home to play, as is the case with older children, and hence they were frequently restricted in their playground to the neighbourhood of the midden privies, the effluvia from which, and from the surrounding filth-impregnated soil, may, very possibly, have injuriously affected their health and perhaps have predisposed them to infection by disease.

With respect to the effect of residence in insanitary dwellings as a factor in the diphtheria, there did not appear to be any evidence pointing at all strongly in this direction. Apart from the general dampness of the subsoil, owing to its composition and to the conditions before referred to, damp, dirty, ill-ventilated, and dilapidated dwellings did not appear to specially predispose the people resident in them to diphtheria. A note of the conditions of the dwelling was made in the case of 47 invaded households. In 24 of these the house was damp, dirty, ill-ventilated, or dilapidated; but in 23 the dwelling was well-built and new, or at least in fair condition.

With respect, then, to the origin of the diphtheria, it could not be attributed to any specially insanitary conditions, and it appears probable, either that it was related to throat affections of a similar nature to those which antecedently prevailed among children affected with scarlet fever or measles, or that it was brought into the town from some other place in which the disease was present. From this last point of view it has to be noted that there was a large fair held in the town during the last week in August—at a time, that is to say, when the schools were all closed for the holidays—at which persons attended from all the surrounding towns. The outbreak of the disease occurred in the beginning of September in the weeks immediately following this fair.

With regard to the spread of diphtheria in Hinckley, the influence of infection by contagion from person to person, or by means of fomites, has now to be considered. From this point of view there are several interesting facts to be mentioned. One noteworthy fact was the small power of spreading in invaded households which the disease exhibited, as is shown by multiple attacks occurring in only 13 out of 51 invaded households. The disease also very seldom affected adult persons,

although facilities for its spread among adults were present in the town, owing to the gathering together of the adults in the factories.

It will have been noticed that 61, or 89 per cent., out of 68 cases, were among children of 14 years of age or under; that is to say, among children most of whom would probably be attending school: and it has already been noted that the disease was entirely confined to the households of the working classes, that is to say, of those classes whose children would attend the public elementary schools. It is also noteworthy that, as judged by the death returns, the epidemic commenced in September after the re-opening of the schools: the first death from diphtheria which had been registered since the month of February occurring 10 days after the re-opening of the schools at the termination of the summer holidays, and being followed by a progressively increasing number of deaths from this disease; four deaths occurring in September, eight in October, and 13 in November. Out of 51 invaded households, in 44 instances, or 86 per cent., the first individual to be affected was attending a public elementary school at the time when his or her illness commenced. For the foregoing reasons, therefore, it appears most probable that the disease was spread by the means of infection received whilst attending school. The exemption of the children in the workhouse from diphtheria is in all probability accounted for by the fact that they attended school in the neighbouring village of Burbage, in which village, up to the time at which I commenced inquiry in the urban sanitary district, no case of diphtheria had occurred. At what date and in what manner the disease was first introduced into the schools, it was impossible, owing to the absence of notification of infectious diseases, and the consequent want of information as to the non-fatal cases in the earlier stages of the epidemic, to come to any conclusion. The outbreak might possibly have been preceded by mild cases, which had returned to school after the summer holidays in an infective condition, but I could obtain no evidence of this. The disease having once been introduced into the schools in whatever way, its subsequent spread is easily accounted for. It was found that in several instances children were attending school at a time when a member of their family was suffering from diphtheria; that on recovery children returned to school in the same clothes which they had worn during their illness; that they often returned to school as soon as they appeared to have recovered, without any period of further isolation; and that no attempt had been made to disinfect their houses after diphtheria had occurred in them. It will thus be seen, apart from the possibility of children attending school in the early stages of the disease—and setting aside the suggestion that has been put forward that some forms of sore throat without membrane are capable of communicating diphtheria—that there were abundant opportunities for communication of infection at school, both by personal contagion and from contagion carried by means of the clothes or other fomites.

Out of the 44 children who were the first of their families to be affected by diphtheria, and the onset of whose illness occurred at a time when they were attending a public elementary school, 20 were attending the Church schools, 17 the Board schools, five the Roman Catholic schools, and two the Trinity infant school. The number of children on the books of the Church schools was 326, on those of the Board schools 1,401, on those of the Roman Catholic schools 165, and on those of the Trinity infant school 74: so that there was marked incidence of the disease upon the children attending the Church schools.

I visited all the public elementary schools in Hinckley, and inquired into their sanitary condition, the means that were taken to exclude

children coming from infected households, and as to the general health and appearance of the children in them.

No markedly insanitary conditions were found in any of these schools.

With respect to the exclusion of children from school who were coming from infected households, I found that this duty was left almost entirely in the hands of the teachers. No means had been devised by which the Sanitary Authority should inform the teachers of the presence of diphtheria in the households of children attending the schools. One teacher was in the habit of excluding particular children on hearing that a medical man had been called in to see members of their household suffering from throat affection; at another school the children were only excluded on information reaching the teacher of the presence of diphtheria in their homes; and in a third the teacher sent all children home who appeared to have bad sore throats. It speaks well for the vigilance shown by the teachers, that I did not find any case presenting the typical characters of diphtheria in any of the schools, although the disease was so rife in the town. It was found, however, that in all the schools there were at the time of my visit a number of children suffering either from sore throats or from nasal catarrh; or presenting white patches at the corners of the mouth, on the mucous surface of the lips, or at the margins of the nostrils, in which latter case nasal discharge was also present.

With regard to the clinical feature of the sore throat that was present, the child suffering from it always presented a flushed, swollen, and puffy-looking face; the puffiness being especially noticeable around the eyes. The pulse was quickened, the tongue furred, and the child usually seemed dull and stupid. A distinct general puffy swelling of the tissues of the neck could be observed in many cases, and in all cases of sore throat a marked enlargement of the glands beneath the angles of the jaw on both sides of the neck was detected. On examination of the throat there would be found more or less swelling of the soft palate and fauces, with an increased secretion of mucus, which, especially in younger children, was often present in large quantity on the back of the pharynx. Swelling of the tonsils was present, in some instances, but not invariably. The most characteristic feature in the throat consisted in the presence of bright red, injected, sharply defined, patches, on the soft palate or fauces; much less commonly the surface of the tonsils was also red and injected. These bright red patches in some instances extended all along the margin of the palate. The patches of injection were often, when present on the palate or fauces, studded with enlarged projecting mucous follicles, giving them a velvety appearance. In the centre of these patches of injection was frequently found a white film or pellicle, generally most marked on the palate or fauces, but present in some instances on the tonsils. This film could be scraped off with difficulty, because it had no defined edge, nor did it stand up above the surrounding surface; on removal it left a red, slightly raw surface. The film or pellicle consisted of swollen and sodden epithelium only, and presented none of the characters of diphtheritic membrane. With regard to the characters of the nasal catarrh which was present, the discharge from the nose was in some cases thin and watery, leaving white crusts on the upper lip where it had dried; in others it was offensive and purulent. Accompanying the nasal discharge there was always more or less swelling of the mucous membrane of the pharynx, and an increased secretion of mucus from it. With regard to the cases presenting white patches at the margins of the nostrils or corners of the mouth, or on the lips, these patches consisted of white, slightly raised, swollen and sodden

epithelium, surrounded by an area of bright red injection. In many instances these patches extended some distance from the mucous membrane on to the surface of the neighbouring skin. In several instances also these white patches could be seen to extend some distance along the mucous membrane of the nasal passages, and when present about the nose were always accompanied by a thin watery discharge, but they were not observed on the mucous membrane of the mouth. When these white patches were pulled off, a raw, bleeding surface was left.

As to the degree of prevalence of these affections among the children present in the several schools:—They were by far most common among the children at the Church schools; and among the children at any one school these affections were almost entirely confined to the younger children. They were almost wholly absent in the case of the older children. The younger the child the greater appeared to be its liability to present one or other of these affections. With regard to the relative preponderance of the three affections in question, nasal catarrh was by far the most common, and in some of the class rooms, containing the younger children, nearly all were affected in this way. The form of sore throat before described was also very frequently met with, in many instances accompanied by nasal discharge, but the children presenting white patches at the margins of the mouth and nostrils were few in number.

On the morning when I visited the Church schools there were only 245 children present, the number on the books for the present week being 326. The absence of above 80 children was said by the teachers to be almost entirely due to the prevalence of throat affections among them, or to the presence of undoubted cases of diphtheria in their homes. Among 144 of the younger children in one room, 20 were found to present enlargement of the glands of the neck, with red patches on the fauces, palate, or tonsils, and a white film or pellicle on the red injected surfaces. Of 13 boys in another room, four were suffering from the same form of sore throat. In another room six children were suffering from this sore throat, and in a third room, two children. A large proportion of the children at this school were suffering from nasal discharge, and three presented white patches in the neighbourhood of the mouth or nose. One teacher was suffering from sore throat, and another had lately suffered from a sore throat requiring medical attendance. A comparison of the attendance of the scholars during 1893 with that of the year 1892—the number on the books being nearly equal, *i.e.*, 330 in 1892 and 326 in 1893—showed that the average attendance had not fallen off during the present year to any considerable extent until the first week in October. At this date a marked diminution of attendance took place, the average number of attendants being 19 less than in the corresponding period of last year; and the numbers in the ensuing weeks, up to the week ending November 24th, were 19, 10, 21, 17, 7, 18, 22, and 13, less respectively than in the corresponding periods of 1892.

At the Roman Catholic schools, the number on the books of which for 1893 was 165, 38 children were absent. The mistress of this school informed me that she sent home all children suffering from sore throat. At this school only eight children were found suffering from sore throat out of 127 present; but many others were suffering from nasal discharge.

At the Trinity schools, at which infants only are admitted, there were 66 children present out of 74 on the books. Of these 66 children, only six were found to be suffering from sore thoat, and one child had white

patches at the margin of the nostrils; a large number, however, were suffering from nasal discharge.

At the Board Schools there were 1,401 children on the books. A comparison of attendance for the week ending November 17th, 1893, with that for the corresponding period of 1892, showed a marked falling off of attendance in all the departments, except that of the infant school. The latter in the corresponding period of 1892 happened, however, to be particularly low owing to the prevalence of measles before-mentioned. A number of cases of sore throat were found among the scholars, also many children were suffering from nasal discharge, and a few with white patches at the margin of the mouth or nostrils; but it was especially noticeable that these affections were almost entirely confined to the younger children. In the infants' department 22 children were found to be suffering from sore throat; and in one class in particular, nearly all the children were suffering from nasal catarrh; the contrast between these infants and the older boys and girls, who presented for the most part an extremely healthy appearance, was most marked. The son, aged four, of the headmaster, who was attending the school, had recently suffered from undoubted diphtheria, and several of the teachers had suffered or were suffering from sore throat.

The question whether these before-mentioned affections of the throat, nose, and mouth are of the nature of diphtheria, and are capable of producing diphtheria in other persons by contagion, is one not easy of answer. I found in the course of my inquiry that these affections were very rife among the children in the town generally. All of them had been noticed previously by the Medical Officer of Health as being especially prevalent, and he had observed also that young people of the better classes suffered from them to some extent. In addition I found that the children in many families had been affected in the before-mentioned ways without any cases of recognised diphtheria arising among them; and, further, I found that these affections were present in some instances in families the children of which were all below school age, and, therefore, not likely to have received the contagion, if there were any contagious property in these affections, at school. Again, I found that the children in the workhouse, among whom no case of diphtheria had occurred, were some of them suffering from these affections. For instance, among 13 children under the age of 15 years at the workhouse, one, aged five, presented a white patch at one corner of the mouth, with discharge from the nose and enlarged glands in the neck; another, aged three, had a similar white patch on the mucous surface of the lip, with discharge from the nose and enlarged glands in the neck; three more children, aged two, four, and three years respectively, presented red and injected patches on the soft palate or fauces, and enlarged glands in the neck; and yet another, aged six, presented enlargement of the tonsils, one of which was covered with a white film or pellicle. In the course of the inquiry it seemed to me to be evident that, contrary to what appeared to be the case with respect to the prevalence of diphtheria, these affections of the mouth, throat, and nose, were especially prevalent among children in houses the conditions and surroundings of which were especially unwholesome. In many houses, the floors of which were of brick, and dirty, where the drains were defective, where privy middens abutted upon the wall of the house, or where other gross insanitary conditions prevailed, all the children were found to be suffering from these affections in one or other form.

For the foregoing reasons, therefore, I regard infection, in this outbreak of diphtheria, as having been in most instances received at school, through the medium of children developing or recovering from diph-

App. A. No. 10. On Diphtheria in Hinckley U. and R. Districts; by Dr. Wheaton.

theria; or from children attending school from houses where diphtheria was present in circumstances allowing of the infection being carried in their clothes. To the dissemination of diphtheria in this way by infection, the absence of any provision for the notification of infectious disease, neglect of systematic exclusion from school of children coming from infected households, and disregard of disinfection of infected houses and clothing, all undoubtedly conduced.

II.—Hinckley Rural Sanitary District.

The district under the control of the Hinckley Rural Sanitary Authority has an area of 24,463 acres, and had in 1891 a population of 11,061 persons, living in 2,473 houses. The population in 1881 consisted of 9,716 persons living in 2,266 houses, so that there has been an increase in the population of 1,345 persons in the last decade. The district almost completely encircles that of the Hinckley Urban Sanitary Authority, except at one point in the south-west, where this Urban Sanitary District adjoins the district of the Nuneaton Urban Sanitary Authority. The area under the control of the Hinckley Rural Sanitary Authority embraces the parishes of Stony Stanton, Sapcote, Sharnford, Aston Flanville, Burbage, Wolvey, Burton Hastings, Stretton Baskerville, Stoke Golding, Higham, Barwell, Elmsthorpe, and Earl Shilton.

(*a.*) *Sanitary condition of the Hinckley Rural Sanitary District.*

The soil of the whole district consists for the most part of a stiff clay or marl with patches of sand in places. All the villages, with the exception of Sharnford, which is situated on the banks of the River Soar, are placed at a considerable elevation above the sea level; the elevation varying from 300 to 400 feet above Ordnance datum. There is very little intercourse between the inhabitants of the different villages, nearly all the communications taking place through the town of Hinckley. The inhabitants of the village of Stony Stanton are chiefly engaged at the quarries there, those of Earl Shilton are engaged in the manufacture of shoes, those of Stoke Golding, Barwell, and Burbage in the manufacture of hosiery, and the inhabitants of the rest of the villages are chiefly engaged in agriculture. The roads leading to the villages radiate from Hinckley as a centre, and the nearest villages to that town are two miles distant therefrom. As will presently appear, I visited all the villages at which there were public elementary schools, and inquired into the circumstances with which the diphtheria had been associated in those villages in which cases of this disease had occurred.

Water Supply.—The water supply in all the villages, with the exception of Stony Stanton, is derived from wells. The water supply of Stony Stanton is derived from water accumulating in, and pumped from, one of the quarries of the Mount Sorrel "Granite" Company. The water is pumped into a filter, through which it passes into a tank from which it is distributed in pipes by gravitation. This supply has only been introduced during 1893, and many of the houses in the more outlying parts of the village are still supplied from wells which are undoubtedly polluted by privies, pigsties, and faulty house drains, in their neighbourhood. At Burbage there are six public wells, which appear to be free from pollution; and also many private ones, the water from which also appears to be of a satisfactory quality. At Sapcote there is no public water supply; but the wells, which are situated in gardens at some distance from houses, appear to be free from risk of pollution in most instances. Some, however, were observed in dangerous

proximity to pigsties and privies. At Earl Shilton there are several public wells which appear to be free from risk of pollution, but some of the private wells are in close proximity to privies and house drains. At Barwell there are several public wells in the streets. At Higham some of the wells are subject to pollution by privies and pigsties, and this is also the case at Wolvey and Sharnford.

Isolation Provision.—The Rural Sanitary Authority has made no provision for the isolation in hospital of cases of infectious disease.

Disinfection.—Fumigation and lime-washing of houses in which cases of infectious disease have occurred, are performed under the superintendence of the Inspector of Nuisances; but the Authority possesses no apparatus for the disinfection of clothes and bedding.

The Infectious Disease (Notification) Act, 1889, was adopted by the Authority early in 1890.

Sewerage.—All the villages have sewers, which are usually composed of sanitary pipes, and which discharge their contents into ditches or brooks; at Sapcote and Stoke Golding the sewage enters ditches close to the villages. Attempt has been made to distribute the sewage over furrows in the land, before discharging it into watercourses, at Barwell and Burbage only. The sewers are, as a rule, unprovided with means of inspection, ventilation, or flushing.

House Drainage.—The house drains are properly trapped in most of the villages, with the exception of Higham, Sharnford, and Wolvey. In these villages the house drains are very defective; but they do not communicate with the interior of the houses, the gulleys down which the slops are thrown being usually situated at some distance from the houses.

Excrement disposal is effected almost exclusively by means of privy middens. These middens, although uncovered, uncemented, sunk below the ground level in many instances, and situated so as to endanger the purity of water in wells, are, as a rule, at some distance from the houses. Considerable improvement in the condition of these privy middens has been effected in some of the villages of late years by the action of the Sanitary Authority. Scavenging is performed by private owners and by occupiers, and appears as a rule to be regularly carried out. Accumulations of filth in middens were not common in the district.

House Accommodation.—Most of the houses in the manufacturing villages are comparatively new structures, and they are in good condition; but at Wolvey, Sharnford, and Higham there are many old, dirty, and dilapidated houses. In the three last-mentioned villages also, many of the houses are damp owing to absence of eave spouting, and the yards and spaces around them are wet and sloppy from the absence of paving.

Nuisances arising from the Keeping of Animals.—In many instances pigs are kept in undrained sties, so as to give rise to nuisance.

The *slaughter-houses and bakehouses* appear to be, as a rule, in good condition.

Cowsheds and Dairies.—A register of these is kept, and they are inspected by the Inspector of Nuisances; they appear to be for the most part clean and well ordered. There are no milk shops.

There are no *common lodging-houses* in the district.

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(b.) *Diphtheria in the Hinckley Rural Sanitary District.*

With regard to the prevalence of diphtheria in the Hinckley Rural Sanitary District, it should be in the first place noted that in 1890, in which year the Infectious Disease (Notification) Act first came into force in the district, no cases of diphtheria were notified to the Rural Sanitary Authority, although one death was returned as due to this disease. In the year 1891 no cases of diphtheria were notified, and no deaths were returned as being due to this disease. In 1892 five cases of diphtheria were notified to the Rural Sanitary Authority, two in Stony Stanton, and one each in the villages of Sharnford, Burbage, and Barwell; and one death occurred from this disease. During the latter part of 1892 scarlet fever of a mild type appeared in the district; 45 cases were notified at Stony Stanton, and a few cases in the villages of Sharnford, Earl Shilton, and Barwell. Two deaths from scarlet fever also occurred in this year. Measles does not appear to have been prevalent in the district in 1892, except at Stony Stanton, in which village a number of cases occurred in the autumn. Dr. King, the only resident medical practitioner in this village, informs me that several persons attacked by measles suffered from throat complications, and two fatal cases presented a false membrane in the throat. At the latter end of 1892 and the beginning of 1893 several instances of scarlet fever with throat complications, some of them presenting distinct membrane on the fauces, were observed by Dr. King at Stony Stanton. During 1893 the first case of diphtheria occurring in the district was notified on January 26th; in this month three cases were notified, in February three cases, in March two cases; in April one case, in May two, in July two, in August three cases were notified; all in the village of Stony Stanton. In October three additional cases were notified in Stony Stanton, one case at Stoke Golding, and one in the hamlet of Sketchley in the parish of Burbage. In November one case was notified from Stony Stanton, one from a farmhouse in the parish of Burbage, another from an isolated row of cottages in the same parish, one at Barwell, and one at Earl Shilton; making altogether 26 cases of diphtheria notified up to November 28th, 1893. Seven deaths were returned as due to this disease in the same period. Four of these deaths occurred at Stoke Golding,* one at Stony Stanton, and two at Earl Shilton. In the course of my inquiry it was found that some cases of diphtheria had not been notified, and that at least 34 cases of diphtheria had occurred in the district up to November 28th. I visited all the houses in which, so far as I could ascertain, cases of diphtheria had occurred; as also the public elementary schools in all the villages at which such schools existed. In these visits I was accompanied by Mr. W. D. Bennett, the Inspector of Nuisances, whose extensive knowledge of the district, and of its sanitary condition, was of great assistance to me in my investigations. In the course of inquiry it became evident that the origin and progress of the diphtheria could not be attributed to infection through the medium of water or milk. It was also found that the prevalence of the disease bore no obvious relation to the existence of insanitary conditions, such as dampness of

* It will be noted that four deaths from diphtheria occurred at Stoke Golding, whereas only one case of this disease (a late case of a series) had been notified to the Sanitary Authority as occurring in this village.

houses, untrapped and defective house drains, unpaved and filthy yards, or filthy and dilapidated dwellings; for in those villages in which these defects were most marked, such as Wolvey, Sharnford, Higham, and Sapcote, diphtheria, or at any rate recognised diphtheria, had been absent. The preventive measures which had been taken under the direction of the Rural Sanitary Authority during the outbreak of diphtheria, consisted in the lime-washing of infected houses, the fumigation of rooms by means of sulphur, the flushing of drains, and the cleansing of yards and privies. No special means had been employed for the disinfection of clothes and bedding. The schoolmasters and mistresses were informed by the Inspector of Nuisances of all the known invaded households from which children were attending school; and the children coming from such households were excluded from school attendance as far as possible. But I found that in several instances this prohibition had not been successfully enforced.

I now proceed to give a short account of the circumstances attending the outbreaks of diphtheria which occurred in certain of the parishes in this Rural Sanitary District.

(1.) *Diphtheria at Stony Stanton.* (Population, 1,220.)

Twenty-two attacks of diphtheria in 14 houses are known to have occurred in this village in 1893. The invaded households were scattered all over the village, but there was some exceptional incidence of diphtheria in a row of cottages, 20 in number, the sanitary condition of which was very good. In this row of cottages three of the invaded households were located. The first inhabitant of these cottages who was attacked by diphtheria was a child who was attending the school in the village; and there seemed every probability that the subsequent attacks among inhabitants of these cottages, which were all in persons above 13 years of age, were due to personal infection from this case. Taking the village as a whole, it was found that, as regards 14 invaded households, the first case—and this was in most instances the only case—of diphtheria occurred in a child attending the village school in 10 instances; and in two instances where the first sufferer was not attending school, some other member of the family was attending school at the time when the illness commenced. Multiple attacks occurred in four households. Dr. King informed me that he was of opinion that a number of other and mild attacks of diphtheria had occurred among children in the village, to whom no medical practitioner had been called in. In several instances I found that children had attended school whilst a member of the family was suffering from diphtheria, and that children returned to school after recovery from the disease without any disinfection of their clothing; so that there were abundant opportunities for the spread of the disease by contagion at the school. On visiting the school at Stony Stanton, I found that, although the average attendance of the scholars had been low throughout the year, there had been no marked falling off at any one time; and this was consistent with the facts as to the prevalence of the diphtheria during the year. There had been no great outburst of the disease, though cases had occurred, month by month, in a way suggestive of repeated re-introduction of infection to the school by children returning there after recovery from illness. Out of 22 attacks of diphtheria in this village 14 of the sufferers were below the age of 14 years.

The schools at Stony Stanton were in good sanitary condition. On examining the children assembled there I found that a large number of them were suffering from nasal catarrh and from the affections of the throat, mouth, and nostril, described as existing among the children at the schools in the Hinckley Urban Sanitary District. In one class room, out of 50 children, eight were suffering from that form of sore throat, with enlargement of the glands of the neck, which I have already described; in another room containing 22 infants, 11 were suffering from sore throat, and four had in addition white patches at the corners of their mouths. Among 86 older children, four were suffering from sore throat, and one child presented in addition to sore throat white patches at the corners of the mouth. The older children in the upper standards were almost entirely exempt from these affections. In several of the invaded households young children were found suffering from nasal catarrh or from sore throat, or presented white patches at the angles of their mouths. But these affections were also found to be present among the younger children in households in the village in which recognised diphtheria had not occurred.

(2.) *Diphtheria at Stoke Golding.* (Population, 619.)

In this village four deaths from diphtheria occurred in 1893, three in August and one in October. These deaths occurred in one household, which consisted of eight children (all under the age of 12 years), their parents, and two servants. The house was an isolated one, and newly built. A vault privy was in use which was situated at some distance from the house, and was also used by workpeople at a factory.

The behaviour of diphtheria in this household illustrates the marked predisposition to fatal diphtheria which appears to exist in some families. Out of five children attacked by the disease four died. The history of the outbreak is as follows: Owing to the illness of the mother, which was not connected in any way with the diphtheria, the younger children were sent to a neighbouring cottage to nurse. Whilst at this cottage one of these children, a female infant aged six weeks, was taken ill on August 19th, with what was at first supposed to be "thrush," but which the medical man who was called in pronounced to be diphtheria. On August 16th, a sister of this infant, aged three years, who had been away from home for some weeks, on a visit to a friend's house, returned home. She visited the other children at the cottage, but did not reside there; and on August 23rd she also was taken ill with diphtheria. Both of these children died on the same day, August 25th, one dying at home, the other at the cottage. About the same time the first-mentioned child was taken ill, another sister aged six was attacked, and died on August 28th. On August 29th a "white speck" was noticed on the throat of an elder sister aged 11 years, but did not spread further, and the child soon recovered. After the death of the three children the remaining five were sent away to another cottage, and the house of the parents, at which the last-mentioned fatal case had died, was disinfected; but this does not seem to have been done in the case of the cottage at which the child which had been attacked first had died. The disinfection in question was performed by burning sulphur in the rooms and whitewashing the ceiling, but the beds which were left in the rooms during the sulphuring process, were not disinfected in any other way. After the return, about September 25th, of the children to their own home, a boy aged five was seized with diphtheria on October 2nd, and

died on October 5th. With regard to the boy last mentioned, it seemed at first probable that he had contracted diphtheria infection on returning home, notwithstanding that the house had been disinfected; but I found that he had suffered from sore throat on or about August 29th, that is to say, at a time when his sister, aged 11, also had sore throat, and it appears to me to be more probable that this was an instance of recrudescence or relapse of diphtheria in a child who had already suffered from a mild attack of the disease.

With regard to the origin of this limited but fatal outbreak of diphtheria:—I found that early in August four children living in a cottage next door but one to the cottage in which the child, which apparently was the first of those attacked during the outbreak, was staying, had suffered, from what were said by the medical man called in to attend them to be slight attacks of diphtheria. The first of these children, a girl, M. P., aged seven years, was attacked on or about August 16th. One of these children, a female aged 10 months, died on September 16th, the cause of death being returned as "diphtheritic "ulceration of the thigh." It appears that this child, after suffering from sore throat, had some swelling of the vulva, and a sore place, which was said to be covered with a "white substance," appeared in the right groin. It therefore seemed probable that the child, who died in the cottage next but one on August 25th, contracted the disease by infection from the girl M. P., since there was a good deal of communication between the inhabitants of the two cottages; and that the subsequent cases in both families arose from contagion carried from one child to another. With regard to the origin of the infection in the first instance, it appears that a fair was held in the village on August 6th, at which the child, M. P., was certainly present, together with other members of her family. This fair was attended by many persons from Hinckley and the surrounding villages, and ice creams and other articles of food brought from Hinckley were sold there. It is possible that the infection may have been contracted at this fair, although the child, M. P., was not discovered to be ill until about 10 days afterwards.

The building in which the school is held at Stoke Golding was not intended for that purpose. The boys' school is light and fairly well ventilated, but the girls' and infants' schoolroom is partly below the level of the road; moreover it is situated under the boys' school and is badly lighted and ventilated. The room is also barely 10 feet in height. All the children appeared healthy in the boys' school. In the girls' and infants' room there were, out of 63 children, 12 suffering from nasal discharge, and five suffering from sore throat of the character already described. The mistress also was suffering from sore throat. It should be noted that at the time at which the outbreak of diphtheria occurred in this village, the school was closed for the summer holidays, and this may explain the fact that no further cases of diphtheria have occurred there up to the present time.

(3.) *Diphtheria at Earl Shilton.* (Population, 2,594.)

A localised outbreak has occurred in this village, which has been confined to two households up to December. The first attack occurred in the person of a boy, F. F., aged four years, who was taken ill on November 4th and died on November 13th. The house in which this

villages in which cases of diphtheria had occurred in the village itself, and where it was possible that children had returned to school after recovery from diphtheria: namely, the villages of Stony Stanton and Stoke Golding: so that it appears to be highly probable that these affections are related directly or indirectly to diphtheria. No relation was discovered in the Rural Sanitary District between the prevalence of these last-named affections among children and insanitary conditions of their homes or of their surroundings.

No. 11.

Report on an Outbreak of an Epidemic Skin Disease; by Dr. S. Monckton Copeman.

I.—BETHNAL GREEN INFIRMARY.

In May 1893 the Board learnt, through Dr. Downes, of the occurrence in the sick wards of the Bethnal Green Workhouse of about 50 cases of epidemic skin disease "similar," as Dr. Downes says in his minute (of May 19th) on the matter, "to the serious and fatal form which prevailed "in Paddington and Marylebone Infirmaries two or three years ago."

About the same time a letter was received from the Clerk to the Bethnal Green Guardians in which he states that he is directed to inform the Board that "a serious epidemic of contagious skin disease has broken "out in the infirmary of the workhouse," and asking that the Board would at once give instructions for an inspector to visit the place to inquire into the causes of the disease, and also to advise as to the treatment of the cases.

An investigation of the circumstances of the outbreak was, in consequence, ordered by the Board, and I received instructions to undertake it. At the same time the Guardians were informed that if they were desirous of obtaining the services of an expert for the purpose of advising them as to the treatment of the cases, it would rest with them to obtain such services. They were, however, given to understand that no parallel inquiry as to the cause of the outbreak should be undertaken by anyone employed by them while the matter was under investigation by the Board.

Previous History of the Disease.

More than two years prior to the outbreak in the Bethnal Green Workhouse Infirmary a large number of similar cases had come under observation in other of the Metropolitan infirmaries, and it is therefore desirable in the first place to submit a brief outline of the history of the disease up to the time of the outbreak at present under consideration. This is well given in a minute (of date May 22nd, 1893) by Dr. Downes, which I therefore append—

"Attention was first directed to it (the skin disease in question)
"in 1891 by Dr. Savill, the then Medical Superintendent of
"Paddington Infirmary and Medical Officer of the Paddington
"Workhouse. Dr. Savill has since published a valuable account
"of this serious malady.

"Of 846 patients who passed under treatment in the sick wards
"of Paddington Infirmary and Workhouse between July 1st and
"October 31st, 1891, 163 or 19·2 per cent. were attacked by this
"skin disease and 28 of them died. Seven of the 28 succumbed
"chiefly to some other disease, but in 21 or 12·8 per cent. of the
"cases 'death was directly dependent on the epidemic malady.'
"This skin disease, therefore, seriously endangers life.

"It was at first called epidemic eczema, because of the close resem-
"blance of many of the cases to the raw and weeping state of skin
"not uncommonly known as acute general eczema. But Dr. Savill
"has advanced weighty reasons to show that the disease now in
"question is distinct from ordinary eczema.

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On an Outbreak of Epidemic Skin Disease by Dr. Copeman.

"Essentially it is an inflammation of the skin, sometimes dry, "sometimes moist and discharging, but always attended by more or "less peeling of the cuticle. In some cases this exfoliation is so "extensive that the whole cuticle of the hand may come off like "a glove, and the bed is often filled with flakes and scales.

"The whole skin from head to foot may be attacked. In severe "cases of the 'moist' type weeping cracks, and extensive red raw "surfaces are formed and a sickening odour is given off. The eyes "are commonly inflamed and discharging.

"In some of the worst-looking cases the patients have told me "that they felt no pain. Dr. Savill, however, states that in a "typical case the skin is 'raw and acutely tender' with 'intolerable "'itching and burning.'

"The average duration of the disease is six to eight weeks. In "fatal cases death usually comes by profound weakness with "drowsiness, deepening at last into coma.

"There are all degrees of severity and many varieties both in "the condition of the skin and in the constitutional symptoms.

"Of the causes of this singular disease we know practically nothing, "and, in the absence of such knowledge, are almost powerless to "prevent it. It was not wholly confined to Paddington.

"They had had some cases in Marylebone Infirmary, also in "Lambeth Infirmary, in 1891, and there is some recollection of an "outbreak in 1888 in a Scotch Poorhouse (Greenock), where some "50 persons were attacked and 12 died.

"The disease in 1891 was less severe in Marylebone than in "Paddington Infirmary—the death-rate being only 5 per cent. "of the 193 persons attacked. I understand that St. Mary's "Hospital had four cases with one death in 1891, and that there "was a solitary but fatal case in the Female Lock Hospital. At "Hanwell Asylum 38 cases occurred, and at Lambeth Infirmary "25 cases in 1891.

"In the provinces and elsewhere in London the disease was not "observed at that time.

"It is a disease chiefly of hot weather, July and August being "the months in which the great majority of cases occurred. It has "a distinct preference for sick wards, and most of the sufferers are "persons advanced in years. Children and young persons are but "slightly attacked.

"There is reason to believe that it is contagious. Dr. Savill "himself had a slight attack, the Medical Officer of Bethnal Green "Workhouse also has caught it, so did seven out of eleven wards-"people or pauper nurses in Paddington Workhouse sick wards.

"Soap has been suspected, but apparently excluded.

"Dr. Savill considered that there was no evidence to inculpate "any article of dietary, but he remarks that the same contractors "supplied milk and fish to both Paddington and Marylebone, and "the Medical Officer of Bethnal Green, though rightly expressing a "very guarded and cautious opinion, is struck by the present "exemption of the workhouse proper and the infirm wards where "little milk is used, as compared with his sick wards.

"I hope I have said enough to indicate the gravity of this disease "and the importance of careful and systematic study of every "appearance of it."

I found from office records that Dr. Downes had at the time of the first known prevalence of the disease in 1891 sent a circular letter to the medical officer of those provincial workhouse infirmaries (113 in

number) which have over 100 beds each, asking if they had observed during the current year any unusual number of cases of acute general eczema or of pityriasis rubra. On 13th October 1891 he notes that he had received 80 replies. "From these," he says, "it is clear that, with "one possible exception, there has been nothing of the kind in the "workhouse infirmaries to which these replies relate. It is, indeed, "remarkable how many of the medical officers state that they have "been unusually free from skin cases this year, and it would appear "that pityriasis rubra, even in its ordinary sporadic form, is a disease "by no means common in the poor law sick wards of the provinces. "The one possible exception is Bath, the medical officer of which "workhouse reports that he has had under his care this year not only "an unusual number of cases of eczema, but also several cases of "pityriasis rubra."

In 1893 again, as soon as the disease was known to have declared itself at Bethnal Green, Dr. Downes wrote to the medical superintendents of the various Metropolitan Poor Law Infirmaries requesting information as to whether there was any undue prevalence of eczematous disease. From all of them except one a reply in the negative was received, and this one referred to a single case only; but I shortly afterwards learnt that there were several cases at the City of London Infirmary at Bow, and I therefore visited this institution as well as the Bethnal Green Infirmary and carried out an investigation of the circumstances of the outbreak in both places concurrently. At a still later date I was informed by the Medical Superintendent of the St. Marylebone Infirmary, where the incidence of the disease had been extremely heavy in 1891, that several cases had again broken out there, but as at the time the information reached me I was engaged with the work of the General Cholera Survey, I was unfortunately unable in this instance to make any inquiries on the spot. I propose, therefore, in this report to confine myself almost entirely to the state of affairs which I found to exist at the Bethnal Green Infirmary, as far as the results of my investigation enable me to do so, adding only in reference to the City of London Infirmary such details as may appear to be of interest in relation to the practically simultaneous outbreak at Bethnal Green.

To the latter institution I paid a number of visits, but I experienced no little difficulty in my investigation, owing to the fact that the records kept there are of a very imperfect nature. And this is hardly to be wondered at when the numbers of sick to be attended in the wards by the medical officer and his assistant are taken into consideration, especially in view of the most unsatisfactory and inadequate arrangements which at present exist for nursing the patients in this institution. With this subject it will be necessary to deal at a later stage of this report.

In Addendum B. is given a complete list of all patients attacked at the Bethnal Green institution between May 4th, 1893, when the disease first appeared, and June 10th, 1893, between which dates 86 cases are known to have occurred. All these cases, with five exceptions, broke out in the sick wards of the Infirmary; the Workhouse, with the exceptions mentioned above, together with the infirm wards of the Infirmary, which are practically in one building, have remained completely free; and this, notwithstanding that patients who are well enough mix daily in the airing yards and day rooms which are common to the Workhouse and the Infirmary alike. It is also worthy of note in this connexion that the inmates of the Workhouse have every day to pass through a portion of the Infirmary in order to reach the dining hall.

History of the Outbreak.

During the third week of April 1893 a general loss of appetite was observed, according to the Medical Superintendent, to be prevalent in the sick wards of the Infirmary though *not* in the Workhouse itself nor in the infirm wards of the Infirmary; and for indisposition of this sort, limited in the above sense, no sufficient explanation could at that time be found. A fortnight later, attention was first directed to the disease in question by the appearance of eruptions, more or less resembling one another in character, among some of the more elderly and debilitated of the patients in the Infirmary. Seven cases were found to have become attacked in this way when the medical officers went the round of the wards on the morning of May 4th, these being among those who had suffered from notable loss of appetite about a fortnight previously.

That loss of appetite in the above degree in reality marked the time of invasion, gets support from the case of the Medical Superintendent, in which the sequence of events was as follows:—On April 25th he experienced a feeling of nausea, accompanied by loss of appetite and certain other symptoms. About 10 days later his face felt to him to be hot and "burning," and this subjective symptom was followed on May 10th by an eruption on his face, which he considered to be similar in character to that which he had had under treatment in the wards during the previous week. A week later, a similar rash appeared symmetrically on both wrists at the base of the thumbs. Unlike certain of the cases in the Infirmary, however, the rash when once developed was not accompanied by any itching either of face or hands.

The *incubation period* of the disease could not be determined with any amount of certainty, owing to the fact that the origin of the particular epidemic under consideration still remains obscure. At first, indeed, seeing that some of the earlier cases were, shortly after the appearance of their rash, transferred to other wards in which previously there had not been a case of the disease, but in which subsequently other cases broke out, hope was entertained of useful information on this subject. But it was soon seen that any inference from the above facts as to incubation period was open to two sources of fallacy. For, in the first place, although there was reason to believe that the disease was really infectious, it was impossible to assert positively that any cases newly occurring in a ward into which a patient suffering from the disease had been taken, had thereby incurred infection *immediately* on such patient being admitted, and secondly it was out of question to exclude the possibility that such apparently secondary cases had not in reality become infected from continuing action over a larger area of the same cause which brought about the appearance of the disease in the patients first attacked.

In support, however, of the view that cases thus occurring in wards where no previous case had been observed, subsequent to the reception in them of a patient from another ward, had contracted the disease from such other patient, may be cited the fact that in several instances of multiple attacks in a given ward, extension of the disease was first observed in the case of patients occupying beds immediately adjoining that of the case introduced from without. In this manner the disease spread in one or two of the wards, from bed to bed, at longer or shorter intervals, all along one or both sides of the ward.

With the reservations above mentioned, the following cases may perhaps be cited as perhaps throwing some light on the incubation period of the disease. Thus on May 11th, 1893, two persons in Ward No. 26 were found to be attacked, and they were therefore promptly removed to

Ward No. 28. Although this precaution was carried out, two further attacks occurred in Ward No. 26, one (No. 60) on May 22nd, and another (No. 70) on May 25th. Again, case No. 3 was in like manner removed from Ward No. 15 to Ward No. 22, on May 4th, but two other cases cropped up in Ward No. 15, from which this patient was removed, at intervals of 20 days (No. 70), and of 23 days (No. 73) respectively. In Ward No. 22 *to which* the patient was removed on 4th May, further cases afterwards appeared, as is shown in the following table :—

No. of Patient in List.	Date of Attack (Eruption).
30	May 12th.
35	May 14th.
36	May 14th.
43	May 16th.
53	May 20th.
57	May 21st.
64	May 22nd.

Symptoms: Constitutional and Subjective.

At the Bethnal Green Infirmary the amount of work devolving on the medical officers, who are not provided with clinical assistants, is so great that it is impossible for them to keep proper records of the medical history of the large number of patients admitted. I am therefore unable to append any detailed account of the progress of the disease as witnessed in the cases which came under treatment during the prevalence of the epidemic at this Infirmary.* I found, however, that the Assistant Medical Officer of the City of London Infirmary at Bow had preserved notes of certain of the cases which he had under treatment in March, April, and May 1893, and although these notes are not in all respects as full as could be wished, still, as they give some detailed account of the more prominent symptoms which obtained among the patients suffering from this disease, I think it desirable to place them on record here.

Case No. 1.

Name : Annie M——, aged 45.
Occupation : General Servant.
Date of admission : September 14th, 1892 (fourth time).

This patient was re-admitted to the Bow Infirmary in September 1892, complaining of rheumatism, she having been under treatment there in 1888 for "eczema capitis." In October 1892 she showed signs of mental weakness, with paroxysms of violent temper ; was aggressive, showed loss of memory, &c., and was consequently entered with the imbecile and insane class. About the same time her appetite began to fail, and she was complaining of sleeplessness and general debility, with slight gastric disturbance, loss of appetite, nausea, flatulence, and constipation. She was treated with light and nutritious diet and stomachic tonics. There was for a time marked improvement. On March 6th, 1893, however, she complained of an intolerable irritation of her face and forearms for the relief of which she scratched herself. A circumscribed papular eruption made its appearance, which soon ran together and spread itself over the

* I append to this report photographs of certain of the Bethnal Green cases, the originals of which were taken by Dr. F. J. Warwick, who has kindly allowed them to be reproduced. Each photograph is accompanied by short clinical note supplied by Dr. Knox, the Medical Superintendent.

whole body, but persisted in severer form about the head, face, neck, and upper part of chest. There was much redness resembling "erythema nodosum." In the course of a week, parts [illegible] scaly. The eyelids and face were swollen and œdematous. On March 10th the temperature reached 103°, rising at night and falling slightly in the morning. The urine was febrile, it contained no albumen. For eight days the temperature remained high, but fell on the eighth day "by crisis" to a point slightly sub-normal, and did not again attain 100°. The whole body was by this time covered with fine powdery scales, which when washed off left the surface beneath "erythematous" and angry looking. The itching was still very great; application of almond oil and hydrocyanic acid relieved this greatly for a time, but after a few days the patient would not submit to treatment, saying she was being poisoned. Iod. ansm. and arsenic were given internally for a few days only. She remained in this condition until early in May, when the eruption began to die away, leaving the skin dry, harsh, and brawny, and still very irritable. On May 25th her limbs and body were fairly clean, but there still were some signs of the disease about the face.

Gastric and intestinal disturbance was the most prominent symptom throughout the attack.

No specific history.

Later, her general condition very much improved. The surface of her body is still rough with powdery scales. Her legs in the most dependent parts are discoloured, as is sometimes seen in pregnant women or as a result of scorching in front of fire.

Case No. 2.

Name: Sarah C——, aged 65.
Occupation: Laundry Woman.
Date of admission: October 17th, 1887.

The patient has been an inmate of the Bow Infirmary since 1887, suffering from prolapsus uteri and descending sclerosis, following on hemiplegia from hæmorrhage.

For this last 18 months she has been confined to her bed, being quite unable to help herself. Her general health and condition are not so very bad, however, and her appetite has been decidedly good. Owing to her age and affliction, her "vitality" must be said to be "low." Her heart and lungs are free from organic disease.

On April 6th, 1893, the nurse in washing her noticed a peculiar papular eruption on her trunk, arms, and legs, and called my attention to her. This subsequently extended to the face. In the course of a few days the skin began to crack in parts and became scaly. At the same time she lost her appetite and had slight gastro-intestinal disturbance, which only lasted a few days. Her temperature was taken night and morning, but did not rise above normal. In the course of another week the skin became covered with a powdery desquamation, and all constitutional disturbance ceased. In the middle of May she was free from the attack.

Case No. 3.

Name: Julia V——, aged 72.
Occupation: Needlewoman.
Date of admission: January 1893.

The patient was admitted to the Bow Infirmary in January 1893 from "Homerton," where she had been three weeks. Beyond a little bronchial catarrh and dyspnœa, her chief trouble appeared to be her "old age." She states, however, that she has for some years been subject to a rash which came out about the head and face, and which has been always very irritable. It always made its appearance in the spring time and lasted for some months. It was treated with carbolic lotion, and eventually quite disappeared. In the early part of April 1893 she had an attack of what looked like erysipelas of the left ear, which extended over the side of the face and down the neck for a distance of 2 to 2½ inches.

There was a semi-fœtid discharge from the meatus. On closer examination the affected surface was seen to be studded with minute whitish papules. There was a serous exudation on to the surface. Her temperature rose (not higher than 101°) for about four days, accompanied with the usual febrile disturbances. Urine contained no albumen. She was treated with diaphoretics until the temperature fell, and the ear was syringed with Condy's fluid. The surface of the skin was subsequently rubbed with ol. amygd. and acid hydrocyanc. dil., which at once relieved the irritation. Her general condition soon improved. The discharge from the ear ceased in 14 days, and much of the erythema about the patch disappeared, leaving it scaly, harsh, and dry. But fresh patches appeared now on the forehead, and the eyelids became swollen and œdematous. On April 24th the patient was delirious, but had no marked rise of temperature. A brisk purge removed head symptoms and produced a good night. There has been no relapse since. Later the hair of her scalp began to fall off, as also did that of her eyelashes and eyebrows. The whole face, head, neck, and upper part of chest gradually became involved, the skin becoming erythematous and scaly, with still an intolerable itching. Her appetite is now good and general condition much improved. (*See* Chart No. 1.)

Case No. 4.

Name: Maria B——, aged 67.
Occupation: Housewife.
Date of admission: June 10th, 1891.

Patient has been an inmate of the Bow Infirmary since 1891, suffering from "debility and destitution."

There is no organic disease that can be detected, but she seems to be prematurely "used up," and a person of delicate constitution.

On April 29th, 1893, the nurse said she thought the woman seemed "very ill," and had refused to take her food. Although a careful examination was made at the time, I could discover nothing to account for her altered condition. Her temperature was taken at the time, but was not above normal. The next morning, however (30th), she had a temperature of 103·1°, and towards midday her body was completely covered with a macular eruption resembling "measles." In fact, it was diagnosed as such, inasmuch as an outbreak of measles was at the time prevalent amongst the children on the floor above. There were well-marked febrile symptoms, with a trace of albumen in the urine. On the morning of the fifth day the temperature began to yield to simple saline treatment (liq. ammon. acet. ʒi. every four hours), and fell to subnormal on the seventh day.

The albuminuria also disappeared. The skin desquamated, and subsequently came away in large flakes, and then cracked at the elbows. It was not until this time that the disease was recognised as similar to the other cases of "skin" disease occurring in old infirmary patients. Even at the present time (June 1893) the skin shows traces of the attack. (*See* Chart No. 2.)

Case No. 5.

Name: Mary J——, aged 45.
Occupation: Charwoman.
Date of admission: October 4th, 1892.

The patient came into the Bow Infirmary for the first time in July 1891, suffering from morbus cordis (acute rheumatism when young), with all the classical "secondary results." At one time her condition was so serious that she was on the "dangerous list," but in spite of all she recovered sufficiently to be able to leave the infirmary in June of the following year. She was re-admitted again on October 4th, 1892, with many of the old symptoms, but of less severity than on the former occasion. By Christmas she was again up, and moving about the ward, and wanted to go out, but was dissuaded from so doing. She was enjoying her

usual patched up health when, on May 3rd, 1893, she was suddenly taken very ill. She was put to bed, and found to have a temperature of 103°, and to be covered with an eruption which she said "itched very much." It was papular and accompanied with considerable erythema. On the fourth day of the disease her temperature fell to 100°, but she had head symptoms, was delirious, and her legs were covered with purpuric spots. She gradually sank and died exhausted on the eighth day. (*See* Chart No. 3.)

Case No. 6.

Name: John J——, aged 84.
Occupation: Railway Guard.
Date of admission: September 1892.

The patient was admitted from Moorfields Hospital in September 1892, having been operated upon for senile cataract, but his mind becoming deranged he was removed here.

On May 6th, 1893, the nurse called me in the evening to see the patient, stating that he had an eruption on his back and loins. On looking closely at his body there was found to be a diffuse erythematous eruption over the back, loins, and abdomen, with a number of minute whitish papules about half the size of a pin's head, showing indistinctly through the redness. His general condition appeared to be about as usual. There was little rise of temperature (99°), but he complained of the great irritation of the skin, and continually scratched himself. His appetite fell off and his bowels were a little constipated, but beyond this he showed none of the gastro-intestinal symptoms that have characterised other cases. The urine was also normal. In the course of a day or two his eyelids became swollen and œdematous. His hair did not fall out. The erythema soon extended over the whole body and then gradually died away, leaving the skin dry, harsh, and brawny. The irritation still persisted.

His condition of mind was much worse throughout the attack. He was also very restless, sleeping indifferently and losing flesh.

He died of asthenia on 4th June 1893.

Case No. 7.

Name: Ellen L——, aged 65.
Occupation:
Date of admission: February 1893.

This patient has been in the Bow Infirmary since February 1893, suffering from chronic bronchitis with cardiac hypertrophy.

On May 22nd, attention was drawn by the nurse to the fact that the trunk and limbs were covered with a diffuse redness. At the same time the skin was dry and hot, and there was a slight rise of temperature (101°). There were no marked digestive disturbances, but she lost her appetite and was constipated. In the course of two or three days the skin became rough, going on to a brawny scaliness, accompanied by great itching.

Case No. 8.

Name: Edward R——, aged 86.
Occupation: Labourer.
Date of admission: March 10th, 1882.

This man has been a patient in the Bow Infirmary since 1882, suffering from chronic bronchitis and emphysema.

On May 28th, 1893, he complained of great irritation of the skin, and his eyelids and face were puffy. There were none of the gastro-intestinal symptoms that accompanied other cases, and beyond a slight rise in temperature for one day, no constitutional disturbance. The urine was free from albumen.

The rash was most marked over the back and was papular in its character. The skin became scaly and red in a few days, and is in that

condition now (June 12th). Altogether his is the mildest case we have had.

Case No. 9.

Name: Mary B——, aged 84.
Occupation: Housewife.
Date of admission: April 7th, 1893.

The patient was sent from Homerton Workhouse to the Bow Infirmary on April 7th, 1893, with "psoriasis guttata" of the elbows and knees. She had had eczema and gout some years ago. She was in the same ward with, and a few beds removed from, another patient who had suffered from "epidemic skin disease" (F. L——), and on May 30th the nurse noticed that she had a copious eruption upon her. On examination it was found to be scaly and resembled the other cases, although there has been a total absence of any constitutional disturbances.

It is interesting to note that in one respect at any rate, the course of the disease, as witnessed in 1893 at Bethnal Green and at Bow, differed from that observed in 1891, at Paddington and Marylebone.

I refer especially to the *body temperature* of patients who were attacked by it. Dr. Savill notes, with reference to this subject, that "the temperature during the earlier period of the eruption was "generally normal, or in many of the older patients subnormal. In "the later stages, when the skin became extensively or severely "inflamed, it went up to 99°, or sometimes 100° in the evening, and "generally down again to normal in the morning. A higher tempera-"ture than this usually indicated the formation of boils or some other "local inflammation."

One of three temperature charts (annexed to this report) of patients in the City of London Infirmary shows a temperature of 103° F., coincident with the appearance of the eruption, and, as far as I have been able to learn, an initial temperature only a couple of degrees lower was not unfrequently noticed both in this Infirmary and also at Bethnal Green, more particularly in those patients in whom a copious eruption appeared at an early stage of their malady. In such cases, the temperature, however, usually fell again after a day or two, but occasional rises during the later progress of the disease were sometimes observed, the cause for which was, for the most part, not at all obvious. The appended charts illustrate these points.

For the rest, the symptoms and course of the disease have been so well and thoroughly dealt with by Dr. Savill, in his description of the Paddington outbreak, that it is unnecessary in this place to go again over the same ground. It will suffice to note the fact that the disease, as it showed itself at Bethnal Green, was indistinguishable clinically from that of the Paddington and Marylebone epidemics; the two varieties of disease, moist and dry, respectively, referred to by Dr. Savill having been intermixed with cases representing every intermediate stage.

Etiology.

In order to facilitate comparison with the experience of the Paddington outbreak of 1891, as reported by Dr. Savill, I give here the results of my own investigation at Bethnal Green, under similarly arranged headings.

A.—Predisposing Causes.

1. *Age.*—With very few exceptions, the patients attacked at Bethnal Green were advanced in years; no children suffered from the disease,

and comparatively few adults below middle age. With reference to the Paddington epidemic of 1891, Dr. Savill says: "Not only did all the "pronounced cases occur in persons past the middle period of life, "but instances might be mentioned where, of several patients equally "exposed to contagion, the younger ones escaped, and the elders con- "tracted the disease. More than one example is within my recollec- "tion where the disease, in its spread along the side of a ward, would "skip over a bed containing a younger person." All which might have been written, with equal truth, in reference to the recent outbreak at Bethnal Green.

With the object of comparing the relative incidence of disease on inmates of the Infirmary in each decade of life, and of ascertaining the actual proportion at each age-period attacked, I append a table prepared for me by Dr. Knox, the Medical Superintendent, on similar lines to that given at page 26 of Dr. Savill's pamphlet.

From this it will be seen that advanced age is obviously "an "important predisposing cause of the disease, and that the predisposition "gradually increases up to 80 years of age."

2. *Sex.*—The appended table also shows that of those attacked, numbering 86 in all, 45 were males, and 41 females, out of a total of 252 male patients, and 230 female patients respectively, giving in each case therefore a per-centage of, as nearly as possible, 17·8. In the Bethnal Green outbreak therefore there does not appear to have been preponderance of attack on the male sex relative to the total number in the Infirmary at the time, as observed by Dr. Savill, at Paddington.

3. *Previous Ill-health and Hospitalism.*—Out of the total number of patients in the Infirmary, 17·8 per cent. were attacked, while of persons in the workhouse itself only five out of a total of 1,321 inmates were attacked, or 0·4 per cent.* Of the five, three were wardsmen (able bodied paupers assisting in the sick wards), one a kitchenmaid in one of the Infirmary ward kitchens, and the fifth was a man employed in the large workhouse kitchen. "From these facts it would seem that previous "sickness and 'hospitalism' are almost as important factors in the "causation as advancing years."

As to *the particular diseases for which patients were being treated* at the time they were attacked by the specific skin affection under consideration, none of them seem to have had influence in determining invasion. For the most part they were chronic diseases, often of long standing, and very possibly they had lessened the normal powers of resistance of the persons in question. Among these diseases were such debilitating conditions as chronic bronchitis, ulcered legs, and phthisis; but there was no special preponderance of attack on any one of these diseases. In several instances, however, the disease from which the patient was suffering at the time of his or her attack by the skin malady is entered as senile dementia or senile decay; from which it would again appear that the specially predisposing cause was for the most part, as already suggested, general enfeeblement of the bodily powers, whether as the result merely of old age, of exhaustion from chronic disease, or of both these factors combined.

4. *General Sanitary Condition of the Infirmary.*—It is not impossible that the amount of the epidemic, and the severity of type of the malady in many of the patients affected, may have depended in some

* If the Medical Superintendent and his servant, who were also attacked, be reckoned as "inmates," this figure would be 0·5.

measure on the fact that the sanitary condition, and also the general arrangements for attendance on and treatment of the patients in the Bethnal Green Infirmary leave much to be desired. The greater number of the wards, on all three floors, are arranged on either side of a central corridor, so that efficient "through" ventilation is not easily attainable. Moreover, the window space is insufficient, as is also the cubic and floor space in relation to the number of patients in each ward, and in consequence an unpleasant "fusty" smell was noticeable on going into many of the wards.

The nursing staff provided was, under these circumstances, inadequate for the needs of the place, and sufficient attention therefore could not be given to the cleanliness of the patients, or of their body or bed-clothing. At the time of my inquiry I found that one and the same nurse was supposed to exercise a general supervision of several wards. Under this nurse a number of wardsmen or wardswomen were employed to distribute the dietaries and look after the patients in various ways. These wardsmen and wardswomen were more or less able-bodied paupers, who were distributed through the Infirmary by day, but who slept in the Workhouse at night. In most of these respects the Bethnal Green system was at disadvantage compared with that of other Metropolitan infirmaries.

B.—Exciting Causes.

The fact that the special symptom, loss of appetite, was observed in a number of persons at one and the same time, with the circumstance that the eruption characteristic of the malady appeared on the same day in seven of these persons distributed in six wards, seemed suggestive of a cause of the outbreak common to a considerable number of people, and led at once to suspicion that some particular article or articles of *food* might have had concern with the outbreak.

This being so, I carried out a detailed inquiry into the matter, having previously, however, turned my attention to certain other points which may first receive brief mention.

For instance, as in previous outbreaks at the Paddington and Marylebone Infirmaries, suspicion had fallen on *soap;* but it soon appeared that this view was untenable, owing to the fact that the same quality of soap had been in use for some considerable period prior to the outbreak.

Irritation of the Skin from coarse flannel vests and from the easily dissipated blue stains of new bed-coverlets was also suggested as perhaps conducing to the outbreak. But these vests did not cover the arms of patients on which the erruption not infrequently first appeared, and new bed-covers had not, I found, been supplied to all those persons first affected.

Yet another suggested factor was the *Regent's Canal,* which is in a very foul condition, and passes within about 50 yards of the ward in which the first patient to be attacked was lying. Not only is there, especially in hot weather, considerable nuisance from the condition of the water itself, but large cargoes of guano, gas refuse, and decomposing bones for manure add their quota to the effluvium. On inquiry at Paddington Infirmary I found also that the canal runs within a few yards of the base of the main ward-pavilions. Although this was so, I was unable to find any reason for supposing that this coincidence had any definite bearing on the matter under consideration, especially as the canal does not run in any such propinquity to the Marylebone or City of London Infirmaries.

The *water supply* is different in each of the several infirmaries that have been affected, and in the case of that at Bethnal Green is obtained

from a well 300 feet deep, the water of which, as shown by chemical analysis, appears to be of good quality.

As in the case of the Paddington outbreak of 1891, reported by Dr. Savill, it did not appear that either *climatic* or *atmospheric causes*, *season*, or *soil* had exerted any recognisable influence on the disease.

With reference to contagion, certain reasons have been brought forward earlier in this report for believing that the malady in question is capable, to a limited extent at any rate, of transmission from affected persons to others in close relation with them.

To return now to the question of food: The various articles of diet in use in the Workhouse, and in the Infirmary, will be seen from the diet tables which are appended to this report.

Certain of these articles can at once be excluded, as, owing to their being in use in the Workhouse only and not in the Infirmary, they obviously cannot have had anything to do with disease causation in that portion of the establishment devoted to the treatment of the sick. Thus *cheese* is in daily use in the Workhouse, but none is supplied in the Infirmary. Again, *potatoes* are practically excluded from the Infirmary diets, as they are not given with the No. 4 diet, which is in most frequent use there.

On the other hand, *fish* is not supplied in the Workhouse, and indeed not to any large extent in the Infirmary, while of that which is used the same quality is supplied both to officers and patients. In the week ending May 8th, 1893, 390 lbs. of fish, including sole, haddock, plaice, and mackerel, were consumed in the Infirmary.

Of the more important articles of diet, not already mentioned, the *bread* is all baked on the premises, and therefore must be of identical quality both in Workhouse and Infirmary.

Meat and *butter* are also of similar quality in each instance, as are also *eggs* and *potatoes*.

Milk is also supposed to be of like quality in both cases, but it must be borne in mind that the amount per head consumed in the Workhouse is considerably less than in the Infirmary.

With the object of finding out, if possible, whether any of these articles of diet, and if so, which, had played any part in spreading the disease, I ascertained, as regards the persons attacked, the number and proportion in each instance of those who had been consuming certain food stuffs daily.

Of the 85 cases attacked during the course of the epidemic—

39 or 45·9	per cent.	were	on a diet	containing meat daily.
22 or 25·9	„	„	„	meat, with eggs and broth, daily.
15 or 17·6	„	„	„	beef-tea daily.
5 or 5·8	„	„	„	mutton broth daily.
19 or 22·3	„	„	„	fish daily.
85 or 100	„	„	„	milk daily.

It is thus seen that of articles of diet supplied from outside, milk was the only one which had been taken in common by all those attacked by the disease; with the exception, of course, of bread, which, as I have previously stated, is all baked on the premises.

Although it by no means necessarily follows that milk had therefore had any causal relationship with the disease, especially as a number of persons both in Workhouse and Infirmary who had consumed daily a certain proportion of milk had escaped attack, the possibility under the circumstances of some such relationship having in reality existed appeared to render it desirable to inquire into the matter in some detail.

The milk consumed both in the Workhouse and Infirmary was, I learnt, supplied by Messrs. A——, of Homerton, who themselves obtained their total stock from numerous farmers (usually about 150) in different parts of the country. From these sources Messrs. A—— received 1,100 to 1,200 barn gallons daily, delivered at St. Pancras Station.

From the station it is distributed by means of carts directly to its destination.

I further learnt from Messrs. A—— that, although in former years they had supplied milk to the Bethnal Green Workhouse and Infirmary, their contract had lapsed for a year from March 27th, 1892—March 28th, 1893, when they again obtained the contract.

These same contractors had, I found, been supplying, uninterruptedly for the past four years, milk to the City of London Infirmary at Bow, where, as already stated, a number of cases of the disease were observed in 1893 almost synchronously in point of time with those at Bethnal Green.

Another public institution, as they informed me, was also being supplied by these contractors, namely, the Victoria Park Hospital for Diseases of the Chest. At this institution, as far as I am aware, no cases of similar disease have been observed.

A number of smaller dealers are also supplied by Messrs. A——, but I did not attempt any investigation of possible incidence of the disease on this portion of the milk-services; the extreme difficulty of the task would in all probability have been incommensurate with any useful results likely to have accrued therefrom.

With reference more particularly to that portion of Messrs. A——'s milk received at St. Pancras Station, which since March 25th, 1893, was distributed to Bethnal Green Workhouse and Infirmary, I learnt from Messrs. A—— that they require a guarantee of quality from every farmer supplying milk, and that in consequence they do not take any special precautions with reference to this point, except that occasionally the amount of cream in the milk from a particular farmer is estimated if complaint has been made by customers believed to have been receiving it. The utility of such a course, however, does not appear very obvious as, up to the time of the appearance of the epidemic at Bethnal Green, the labels containing the names of the farmers had, as a matter of routine, been taken off the churns at St. Pancras, and forwarded to Homerton, *before* the milk was distributed in larger or smaller quantities under the direction of the foreman at the station. In these circumstances it was not possible to say in what direction the milk received from any particular farmer had been distributed.

The average amount which had been supplied to the Workhouse and Infirmary in 1893 was, I learnt, four churns daily, containing about 16 barn gallons, at a contract price of 13*d.* per gallon. The Medical Superintendent informed me that from the commencement of the new contract in March 1893, the quality had been very inferior, the amount of cream never having reached five per cent. in any specimen examined, and frequently not being more than from two to three per cent.

On April 22nd four churns were received at Bethnal Green, having on them name-plates as follows:—

1. T. S——, Rochester, 379
2. E——, Wissendine, 215.
3. K——, Duffield, 49.
4. T. S——, Rochester, 910.

As the contents of all these four churns appeared to be specially poor in quality, samples of Nos. 1, 2, and 3 were sent to Professor Crookshank for bacteriological examination, and a sample of No. 4 to Professor Stokes for chemical analysis. The reports received subsequently from these gentlemen are appended, and it will be noticed that Professor Stokes says of the sample submitted to him, "It is the worst "sample I have ever met with." In consequence, the senior member of the firm of contractors was requested to attend a meeting of the Guardians, but at this meeting it was determined not to summon him before a court of law, as it was considered that "it would be a greater "penalty to keep him to his contract."

When inquiring into the possible causes of the epidemic, I endeavoured to trace the origin of these particular churns, but Messrs. A—— informed me that it did not by any means follow that the milk contained in them had been supplied by the farmers whose names they respectively bore. This certainly was the case in reference to churns Nos. 1 and 4, as Messrs. A—— had not dealt with Smith, of Rochester, for some time previously, but they stated that the name plates had not been taken off the churns, "as it was possible he might be traded with another year." In consequence, it was obviously impossible for me to trace the actual origin of the milk in question.

It further appeared that, when the amount of milk required by Messrs. A—— for distribution exceeded that received from the regular sources, a certain amount of milk would be bought at St. Pancras from other vendors, and that no precautions would be taken at such periods to identify the source of such additional supply.

On being asked whether they had any comments to make on Professor Stokes's analysis of the sample of milk of April 22nd, Messrs. A—— stated that in their belief the milk had been tampered with after leaving their cart, and before it reached the analyst, but they were not able to supply me with any facts in support of this supposition.

After attention had been called in the manner described to the inferior quality of the milk supplied to the Bethnal Green Workhouse and Infirmary in the spring of 1893, its composition, as shown by analysis, improved somewhat; but notwithstanding this being the case, the contract with Messrs. A—— was finally determined by the Guardians on September 29th, 1893.

Thus far it has been shown that during the early part of 1893, and more especially on one particular day rather less than a fortnight prior to the appearance of the first cases of the disease at Bethnal Green, there had been grave reason for complaint as to the quality of the milk supplied to the inmates of the Workhouse and Infirmary. This circumstance, of course, does not afford any proof that the condition of the milk supplied to the institution at this period had causal connexion with the epidemic which broke out shortly afterwards; but it is at any rate consistent with some such relationship, especially when considered in connexion with certain other facts which were elicited during my inquiry.

In the first place it is worthy of note that, as has already been mentioned, the incubation period of the disease has apparently a duration of from 12 to 14 days, and that the first cases of the disease at the Bethnal Green institution, of which no less than seven broke out simultaneously, made their appearance 12 days after that on which the milk had been noticed to be of specially bad quality. The fact that *all*

the patients in the Infirmary did not contract the disease, does not in any way disprove such causal connexion, for as already indicated the aged and more debilitated inmates are to be thought of as specially susceptible to the disease. At first sight, however, it did appear somewhat strange that no cases of the malady should have been observed in any of the infirm wards of the Workhouse, either male or female; but on careful inquiry being made into this circumstance, it appeared that, though with regard to their general surroundings and mode of living these persons had everything in common with the inmates of the Infirmary, they differed from Infirmary inmates in the fact that from their dietary milk was altogether excluded, even as an extra. On the other hand, it will be remembered that, as already stated in this report, milk had been contained in the diets in every instance in the case of those who had contracted the disease.

Apparent exceptions to this rule were found in certain of the wardsmen, able-bodied paupers who act as under nurses in the wards of the Infirmary, but who sleep in the Workhouse itself. Of these men, who receive no milk in their dietary, three were attacked on May 9th, 11th, and 12th respectively. I learnt, however, from their own admission that, although not supposed to have any milk, they not unfrequently abstracted a portion of that supplied to them for the patients' use in the Infirmary, and this to the extent of a pint or possibly more per diem.

From the facts which have been brought forward there is, I think, some reason for the suspicion entertained by the Medical Superintendent that the milk supply may have been concerned in causing the disease.

If, however, this be accepted, we are confronted with the still more difficult question, as to the manner in which infectivity of the milk was brought about. It is not to be denied that certain diseases, such as scarlatina and enteric fever, and possibly diphtheria, may be communicated by milk contaminated by some persons already suffering from the particular disease. Again, there is abundant evidence to prove, in the case of scarlatina, at any rate, that infection, generally of a comparatively mild type, may be caused by the ingestion by human beings of the milk of cows suffering from a peculiar disease in which an eruption appears on the teats and udders of the affected animals. But in the absence here of all trustworthy evidence as to the actual sources of the milk supply, it is obviously impossible to discuss these aspects of the matter. As having, however, possibly some bearing on what has been said with reference to the milk supply, it may be noted that from May 29th onwards a record was kept by the contractors of the sources of both morning and evening supplies of milk delivered by them to Bethnal Green Workhouse and Infirmary, and that coincidently with such precaution being taken, the quality of the milk was found by the Medical Superintendent to have improved. Further, within a week of this date the disease had become practically extinct in this institution, a solitary case only (No. 86) having appeared later (June 10th).

With special reference to the City of London Infirmary at Bow, I was informed by the Medical Superintendent that of the patients attacked by epidemic skin disease in this institution, none had been outside their own wards from the date of their admission to that on which the disease declared itself, and further that no nurse had suffered. Moreover, all the patients in question had been in the institution for a period considerably beyond that to which, as far as is known, the incubation stage of the disease is capable of extending. Hence it would appear that the disease must have become conveyed to the patients in the Infirmary from some outside source. In this connexion it is worthy of note that this institution, at which the outbreak was synchronous in

point of time with that at Bethnal Green, though less in extent, was being served with milk by the same contractors, and that all the persons attacked there had been consumers of this milk.

On the other hand, it should be stated that at this institution at Bow all milk supplied to the patients is supposed, immediately on being received, to be put into cans in which it is "steamed" prior to distribution.

Whether or not this regulation has been invariably observed, it is of course impossible to say, but even though it has been invariably carried out it does not therefore follow that the "steaming" process has been always continued to the extent necessary to ensure perfect sterilization.

On the supposition that the milk supply had some causal relationship with the outbreaks of the epidemic skin disease under consideration, one would reasonably expect that, *other things being equal*, those persons who happened at the time to be receiving the largest amount of milk in their dietary would be not only more likely to suffer from the disease, but also to exhibit its manifestations in more virulent form than other persons whose consumption of milk was more limited in amount.

Accordingly, both at Bethnal Green and at Bow, the attempt was made to classify patients in these infirmaries according to the amount of milk consumed by them, in order to find out, if possible, what difference, if any, there might have been in the incidence of the disease on each class. Such differentiation as could be made, however, did not afford results which can be regarded as possessing any definite value, owing to the circumstance that while every patient in these infirmaries was taking more or less milk, the difference between the largest and the smallest amount consumed respectively was not great.

Nevertheless, and as regards Bethnal Green, the broad facts remain :—

(1.) That the disease has been mainly confined to elderly persons of both sexes, for the most part inmates of the Infirmary on account of chronic ill-health.

(2.) That of inmates answering to this description, only those were attacked who happened at the time to be in receipt of a dietary in which was included a certain amount of milk per diem, ranging from half-a-pint to, in rare instances, three pints; and

(3.) That patients in the "infirm" wards of the Workhouse proper, who in all respects with the solitary exception of milk ingestion appeared to be similarly circumstanced to the inmates of the closely adjoining and aërially connected Infirmary wards, altogether escaped infection.

At the City of London Infirmary at Bow differentiation in the above sense was not possible, owing to the fact that in this place all the patients are supplied with a certain amount of milk per diem.

Upon the whole, although the evidence brought forward in this report with regard to milk ingestion, a not unimportant factor in this particular form of epidemic skin disease, falls short of proving connexion between the two sets of circumstances, a presumption is, I think, afforded that milk was in some way or other concerned in the causation of the malady; and accordingly it seems desirable that careful attention should be directed to milk supply in the event of further outbreaks of the disease occurring in the future.

Pathology.

By way of introduction to Dr. Andrewes's report on the pathology of the disease as observed at Bethnal Green, I make mention briefly of the results recorded by previous investigators of the bacteriology of the

malady; along with certain observations of my own in this direction, undertaken before Dr. Andrewes had, at the Board's instance, become associated in my inquiry for the purpose of detailed study of the pathological questions that were seen to be arising.

At the time of the former outbreak of epidemic skin disease at Paddington Infirmary, the bacteriology of the disease was made the subject of study by Dr. Savill, and more particularly by Dr. Risien Russell, who published the results of his work in the "British "Journal of Dermatology" (No. 42, Vol. IV.). Dr. Russell states, however, that his opportunity for such work unfortunately only came towards the end of the epidemic, so that the amount of material at his disposal was somewhat limited.

The general plan of his research may best be given in his own words:—

"1. The skin of patients suffering from the disease was examined "microscopically for micro-organisms.

"2. Artificial nutrient media (tubes of peptone broth) were "inoculated with blood which was withdrawn from the bodies "of such patients, during life in some cases, and after death in "others.

"3. The under surface of flakes of epithelium, detached from the "bodies of patients, was also employed for inoculating artificial "nutrient media.

"4. The broth culture was used to inoculate gelatine, from "which plate cultures were made in order to separate the colonies, "and from such isolated colonies pure cultures were made on "gelatine, agar-agar, and potato.

"5. From such pure cultures coverglass preparations were made "and various colouring agents used to bring the micro-organism "into evidence.

"6. Animals were inoculated with pure cultures of the "organism.

"7. Finally, control experiments were made. (*a.*) Sections of "skin of patients who were not subjects of the disease were "prepared and stained for organisms exactly as had been done "with the sections of skin from patients suffering from the "disease. (*b.*) Artificial nutrient media were inoculated with the "blood taken from the cavities of the hearts of patients who had "died of some other disease."

As the result of these experiments a particular micro-organism was found in the skin, in a specimen of blood which had been obtained post mortem, and in the skin exudations of patients suffering from this disease, and Dr. Russell considers "that there are ample grounds for "suggesting that probably . . . an etiological relationship between "the organism and the disease does exist."

He further states that in certain respects this organism resembles the staphylococcus pyogenes albus, but distinguishes it from the latter mainly from the fact that the organism found by him in this disease does not liquefy gelatine.

Like Dr. Russell, I myself found that inoculations of blood, exudation, and flakes of skin from affected areas in various nutrient media (which included broth, peptone, gelatine, and agar-agar) gave rise for the most part to colonies of a glistening bluish-white colour, and consisting of a staphylococcus which only liquefied gelatine after the lapse of some considerable time. Occasionally other organisms were found of

which the staphylococcus pyogenes aureus was perhaps the most constant.

In later experiments I found that if before taking a drop of *blood* for inoculation, the skin were carefully scrubbed with soap and water, and then washed first with solution of perchloride of mercury and afterwards with alcohol, the culture tubes invariably remained sterile from whatever situation the blood were taken and whatever the stage of the disease. I had, however, no opportunity of examining specimens of blood after death. From scrapings of inflamed patches of skin, however, and from the under surface of scales newly peeled off, it was always easy to obtain cultivations of the staphylococcus in question; as also from the exudation which occurs in the "moist" variety of the disease.

It would seem therefore that this micro-organism is derived solely from the skin; while from its appearance in cultures and microscopically, it appears identical with the staphylococcus epidermidis albus, which is to be found in skin of healthy persons. In all probability the conditions which obtain in the upper layers of the skin of patients suffering from this disease would afford favourable opportunity for the proliferation of this organism; a fact which would account for its greater abundance in those portions of the skin of the body which are the seat of the special manifestation of the disease under consideration.

(Dr. Andrewes' report, which immediately follows, confirms me in my provisional belief that the organism isolated by various observers, from cases of this disease is, as a matter of fact, identical with the staphylococcus of normal skin.)

May, 1894. S. MONCKTON COPEMAN.

Observations on the Pathology of Epidemic Eczema occurring at Bethnal Green Infirmary; by Frederick W. Andrewes, M.B., M.R.C.P.

The pathology of this disease has been studied by Dr. Savill, Dr. Risien Russell, and others. Dr. Savill states that "the essential "lesion is an inflammation of the derma—a dermatitis," and he adds that there exists a considerable effusion of cells and fluid between the derma and the epidermis, and as a result the latter separates in flakes, scales, or dust. The changes in the derma he found to consist, in the earlier stage, of a large excess of leucocytes, in the later stages of a large excess of fibrous tissue. He brings forward strong evidence as to the contagious character of the malady.

Dr. Savill further describes a diplococcus as constantly present in the exudation from the skin. It was aërobic, grew on all the ordinary culture media, and did not liquefy gelatine, at least for a considerable time, otherwise it bore some resemblance to staphylococcus albus. Dr. Risien Russell, in a paper published in the "British Journal of Dermatology," April 1892, describes the same organism as present in the disease. In sections of affected skin he found that the prevailing microbe was a diplococcus, especially abundant in the deeper layers of the skin. Cultivations from the blood from living cases were not successful; twice he obtained a negative result, once only septic organisms were present, and once staphylococcus pyogenes aureus. In a case in which Dr. Savill had, at the post-mortem examination, sealed blood from the left ventricle in a capillary pipette, and set it aside for

three months, Dr. Russell found only this same diplococcus in the heart blood. On the under surface of desquamating flakes of cuticle the diplococcus was always found. He was unable to find it in the skin of healthy people or in the heart blood of patients who had died of other diseases. Blood from a case of pityriasis rubra showed no diplococci.

Dr. Russell describes the diplococcus as almost as big as Friedländer's diplococcus. The segments are ellipsoidal or rodlike, and there is no capsule to be demonstrated. It grows well in all media, most rapidly at 20° C., and does not liquefy gelatine. The growth is likened to a thin layer of bluish white paint.

Experiments on animals gave no result in Dr. Russell's hands, but Dr. Savill claims in one case to have conveyed disease to a rabbit, from the scurf and blood of which the characteristic diplococcus was recovered.

The cases of "epidemic eczema" which I have examined were confined to the summer months of 1893. They occurred in the Bethnal Green and St. Marylebone Infirmaries, where Dr. Knox at the former, and Dr. Lunn and Dr. Nix at the latter institution were good enough to place every facility in my way. I was especially anxious to meet with well-marked recent cases of the disease, but in this I was only once successful. The epidemics which occurred at these infirmaries during the early summer months were already dying out when I commenced my observations, and in no case was I able to be present at any post-mortem examination in a case of the disease. This deficiency has, however, been in part supplemented by the kindness of Dr. Savill, who placed in Dr. Klein's hands portions of the skin and viscera from three of his fatal cases at the Paddington Infirmary in 1891. These had been properly hardened, and kept in spirit, and were in all respects most suitable for microscopic observation.

The observations which I have made on cases of the disease have consisted in—

(*a.*) Careful microscopic examination of the blood drawn, with due precaution, from actively progressing cases during life, in some cases from the finger, in other cases from patches of acutely inflamed skin.

(*b.*) Cultivation experiments, made from blood so drawn, in various culture media.

(*c.*) Microscopic examination of sections of affected skin, taken in most instances from fatal cases after death, but in one instance from a recent acute case during life.

(*d.*) Cultivation experiments made in various media from the affected skin.

(*e.*) Microscopic examination of sections of certain of the viscera from fatal cases of the disease.

In all cases a Zeiss' $\frac{1}{12}$-in. apochromatic oil immersion lens was used for microscopic examination.

Case I.—Lucy P., aged 69, a patient in Bethnal Green Infirmary, developed "epidemic eczema" on May 8th, the disease commencing on the legs. It was a severe case, and the patient desquamated over the whole body. Seen, with Dr. Knox, on June 20th during the seventh week of the disease, when there were still raw desquamating areas round the ankles. A patch on one ankle was well washed, but not sterilized, and the superficial layers of desquamating epidermis were transferred to a sterile tube. Samples from a somewhat deeper layer were transferred to a sterile tube.

These two samples were subsequently shaken up separately in sterile salt solution, and a number of cultures made from them in nutrient gelatine and agar-agar. These were then incubated at 20° C. and 37° C. respectively. Those from the first superficial sample yielded a number of colonies. The most numerous were colonies of a white staphylococcus which liquefied gelatine much more slowly than the ordinary staphylococcus pyogenes albus, and corresponded closely with the species described as staphylococcus epidermidis albus, commonly present in healthy skin. There were also numerous colonies of a yellow colour, consisting of an actively motile bacillus which I did not succeed in identifying, and one or two of a small white micrococcus, liquefying gelatine more rapidly than the staphylococcus. Cultivations from the second scraping yielded very few colonies, all of the above-mentioned staphylococcus epidermidis albus. The majority of the cultivations made from the second scraping remained sterile.

Case II.—Arthur H., aged 24, was admitted to Bethnal Green Infirmary on May 30th. He had a primary syphilitic sore, and an eruption of a month's duration which was believed to be syphilitic. On June 13th he developed "epidemic eczema," with a rise of temperature lasting several days. On June 20th, the day on which I saw him, there was a recent eruption of wheals, not unlike those of urticaria, on the flexor surface of the forearms. The forearm was cleansed with soap and water, and the surface sterilized with perchloride of mercury. Coverglass preparations were made from blood which exuded from one of the wheals, and cultures of this blood were established in beef broth, on nutrient agar-agar and on gelatine. These were made by collecting the blood in sterile capillary pipettes and immediately transferring it to the media in question. A good sized drop of blood was used for each culture. These were subsequently incubated at 37° C. with the exception of the gelatine tube, and one or two of the agar-agar tubes which were kept at 22°. All the tubes were watched carefully till July 4th, but no trace of growth occurred in any one of them.

The coverglass preparations of the blood from this case were dried and heated in the ordinary way, and stained in Canon's solution (Eosin and methyl blue). An equally negative result attended their examination; nothing abnormal could be found.

Case III.—William H., aged 63, was an in-patient in St. Marylebone Infirmary suffering from a renal tumour, with hæmaturia. I saw him, by the kindness of Dr. Lunn, on September 9th, when he had been affected with "epidemic eczema" for about a week. It was not a severe case and the constitutional symptoms were slight.

A recent dry eczematous spot on the left forearm was selected, washed with soap and water, swabbed with perchloride of mercury solution, and dried. Blood and lymph exuding from the centre of the patch were collected in capillary pipettes, and at once transferred to culture tubes.

Two broth tubes, and one agar-agar and one gelatine tube were thus inoculated; the gelatine tube was kept at 22° C.—the others at 37°. No growth occurred in any tube—though they were watched till October 9th.

Case IV.—John C., aged 58. An infirm old man in the St. Marylebone Infirmary suffering from paralysis agitans. In August he was attacked by "epidemic eczema" in a severe form, and, growing gradually weaker, he died from asthenia on September 7th, six weeks after the onset of the disease. No post-mortem was performed, but I was permitted on September 8th to remove a piece of skin from one

thigh where there were some patches of the disease looking more recent than the rest, but desquamating freely and evidently of some duration. A patch here was washed, sterilized with perchloride of mercury solution, and again washed with sterile salt solution; then, with sterile forceps and scissors, a piece of skin, with the subcutaneous tissue, was excised and transferred to a tube of sterile salt solution.

This piece of skin was subsequently washed again, and then cut in two, half being hardened in alcohol for section cutting, and the other half used for cultivations, which were made in the following manner:—The fragment was laid with the epidermal surface downwards, and the subcutaneous tissue and fat snipped away with sterile instruments. Pieces of the deepest true skin were then excised, the epidermal surface not being quite reached. These were rubbed over the surfaces of four agar-agar and three gelatine tubes, which were incubated as usual—the agar-agar tubes at 37° C. and the gelatine tubes at 22°. Every tube remained quite sterile, except one gelatine tube in which a fragment of skin had been left, and here a single colony of a yellow sarcina—an extremely common contamination—appeared after some time in contact with the piece of skin. The cultures were watched for a month; but no colonies of any sort developed.

Sections were cut out of the piece of skin which had been hardened, and were stained in gentian violet. They showed no characteristic appearances under the microscope, save those attributable to old inflammation. The stratum corneum of the epidermis had almost disappeared, having been exfoliated, or so far loosened as to be detached in cutting the sections. The deep portion of the Malpighian layer showed evidence of active growth and cell proliferation, the nuclei staining deeply. The middle layers showed a few cells in a dropsical condition, with feebly stained nuclei; but this was not the case with most of the cells, nor was there much exudation between the cells. A number of pigment granules of a brownish colour were scattered throughout the Malpighian layer, especially in its deeper part, and clusters of the same granules were present in the corium, where they seemed to represent the degenerate remnants of extravasated blood corpuscles. The number of leucocytes in the corium was increased, but not markedly so. I was unable to demonstrate micro-organisms of any sort in these sections, save a few cocci amongst the still undetached cells of the stratum corneum. None whatever could be found in the corium or in the Malpighian layer of the epithelium.

Case V.—Frederick B., aged 58, had been in St. Marylebone Infirmary in 1892, and had suffered from a severe attack of "epidemic eczema," followed by much exfoliation. He was re-admitted on August 30th, 1893, for slight rheumatoid arthritis. On September 11th he noticed some itching of the backs of the hands, and later, of the thighs and trunk, but there was very little rash visible. On September the 20th the disease broke out acutely all over him, and his temperature at night was 100° F. I saw him, with Dr. Nix, on September 21st. All over the chest were discrete raised red patches, not unlike urticaria. On the arms the patches were confluent, and the condition was suggestive of erysipelas, except that there were discrete patches at the edges of the affected areas. On the thighs and legs the condition was more advanced, the superficial layer of the epidermis being in places raised by a thin scattered layer of seropurulent exudation. The case was thus an acute one in its very early stages, and was the most suitable one for investigation that I was able to come across.

The skin of one forefinger, free from the disease, was washed and cleansed with perchloride of mercury solution. Blood was then drawn

from a puncture, and coverglass preparations and cultivations made; the latter as usual by collecting the blood in a capillary pipette and at once transferring it to two broth tubes, one agar-agar and one gelatine tube.

On the forearm a place was selected where the rash was most recent, and it was washed with soap and water, then with perchloride of mercury solution, and lastly with sterile salt solution. A fragment of the skin and subcutaneous tissue was kindly excised for me by Dr. Nix, with the patient's consent, including the whole thickness of the skin and a little of the subcutaneous tissue. The fragment was about a quarter of an inch in diameter, or rather less. Sterile instruments were used in removing it, and it was transferred at once to a tube of sterile salt solution. With the blood and serum which exuded from the incision, two broth tubes, one gelatine tube, and one agar-agar tube were inoculated.

This skin fragment was subsequently again washed in sterile salt solution, and cut in two with sterile scissors; half being hardened, first in Müller's fluid, and then in alcohol, for section cutting, the other half being used for cultivations. These were made by rubbing the fragment with a sterile platinum spud over the surfaces of two agar-agar, one glycerine agar-agar, and two gelatine tubes. This fragment was then again cut in half, and one piece was rubbed over the surface of a gelatine tube, and left in the tube, which was then melted at 30° C., and poured into a glass capsule. The other piece was used for making coverglass preparations.

Of the preceding cultures, the gelatine tubes were incubated at 22° C., and the other tubes at 37° C. The results were as follows:—The cultures from the blood drawn from the finger all showed growth of one and the same species of organism, a white staphylococcus liquefying gelatine extremely slowly, and which I identify as staphylococcus epidermidis albus, previously mentioned as an organism very common in the human skin. The cultures from the blood drawn from the incision in the forearm yielded a growth of the same staphylococcus in one broth tube; the other three tubes remaining sterile. I think it likely that the growths in the cultures taken from the finger blood were contaminations due to imperfect sterilisation of the skin, and were not truly derived from the blood, not only because the staphylococcus in question is well known as a normal inhabitant of the skin, but also because three out of the four tubes inoculated with blood and serum from the deeper wound in the forearm, and hence much less liable to skin contamination, remained quite sterile. I was not able to detect any micro-organisms in coverglass preparations of the fresh blood stained in Canon's Eosin and methyl blue stain.

The cultivations made from the skin fragment remained sterile, except for a single contaminating colony of a yellow sarcina in one gelatine tube, and one or two contaminations in the gelatine plate, which were probably derived from the air, as none arose in contact with the included fragment of skin, which remained unaltered. The coverglass preparations made from the skin fragment, which were stained, some in gentian violet, some in Canon's solution, also showed no micro-organisms. The results of the bacteriological examination of this very favourable case proved thus entirely negative.

The piece of skin which had been hardened was embedded in paraffin, and cut with a microtome with great care; the sections were stained some in methyl blue, some in gentian violet, some in Cannon's solution, and some in rubin and methyl blue. In the corium no special changes could be detected, except dilatation of the lymph spaces with microfluid; not even any marked increase of leucocytes, and no œdema

organisms were found there. The most noteworthy changes were in the Malpighian layer of the epidermis, where the cells were more or less separated by exudation (with here and there indications of the extravasation of white and even red blood corpuscles) and appeared as very well marked "prickle-cells." These cells, especially the middle and upper layers, were swollen and dropsical, the nuclei staining badly, though the nucleoli were distinct. This change was more marked in some places than in others, and where it was most marked another change was also visible, namely, the appearance of irregular-shaped deeply-stained granules and rod-like bodies amongst and between the epithelial cells. At first sight the belief that these were micro-parasites of some kind was inevitable; they were sharply outlined, and deeply stained, especially in sections stained in gentian violet; but they were very irregular in form, some being spherical, some rod-shaped, some clubbed, and some branched, so that they lacked that uniformity which would have been expected in a given species of bacterium. For some time, however, I entertained hope that they might stand in some relation to the disease, until finally I discovered precisely identical appearances in the Malpighian layer of the skin in a case of human anthrax which had been cut and stained in the same way. I am unable to state their real nature with confidence, but I suspect that they are in part nerve-endings, and in part chromatin granules derived from the breaking-up of the nuclei; perhaps, also, they may be in greater part due to coagulation products of the exudation fluid between the cells. I have been thus unable to demonstrate the existence of any undoubted micro-organisms in the sections of skin from this apparently favourable case.

Further opportunities for studying the histology of the disease were available in some material from three fatal cases which was kindly put at Dr. Klein's disposal by Dr. Savill. These cases were amongst those described at length in Dr. Savill's paper read before the Medical Society of London in November 1891, and which appeared in the British Journal of Dermatalogy in 1892.

Case VI.—George H., aged 82 (Case M. XIV. of Dr. Savill's series), died in the Paddington Infirmary in 1891, six weeks from the commencement of the disease, which had been severe and general, attended by extreme prostration. I have examined sections of two pieces of skin, and of the liver and kidney from this case.

One piece of skin was apparently from the forearm or leg, the other from the palm. They were embedded in paraffin, and cut with a Cambridge rocking microtome (the sections being $\frac{1}{5000}$ in. in thickness) and stained in gentian violet.

The thinner piece of skin showed the stratum corneum almost entirely detached, the well-marked cells of the stratum granulosum forming the apparent free surface. The stratum corneum was doubtless loosened by the process of desquamation, and its detatchment accidental. The superficial layers of the Malpighian stratum were badly stained and showed numerous clumps of yellowish pigment; the cells were in places dropsical. The deep layer of the stratum Malpighii showed well-stained cells, not much separated by effusion; amongst them were numerous granules darkly stained, but irregular in size and shape, resembling the granules of the stratum granulosum, or the irregular fragments of chromatin in some of the nuclei. I could not recognise with certainty any micro-organisms in these sections. The corium showed practically no changes, except the presence of clumps of yellowish pigment.

The piece of skin from the palm showed very similar changes: the stratum corneum was, however, in large part present, and on its surface

and amongst its cells were large numbers of cocci, in clusters and sometimes in pairs; in one place, where a fissure ran down from the surface, a few such cocci could be recognised in the Malpighian layer, but elsewhere I could find no micro-organisms in this layer, nor in the corium.

Sections of the liver and spleen were stained in gentian violet and methyl blue. The liver showed slight cirrhosis and advanced fatty change in many of the cells, with a considerable amount of pigment. The kidney showed the characteristic changes of chronic interstitial nephritis. In neither liver nor kidney could I discover any micro-organisms.

Case VII.—Patrick R., aged 70 (Case M. I. of Dr. Savill's series), died in the Paddington Infirmary, having suffered for 12 weeks from the disease. Extreme prostration preceded death, which was hastened by double pneumonia. From this case I have examined sections of the skin, lung, liver, spleen, and kidney.

The skin was embedded in paraffin, and cut with a microtome as in the preceding case; the sections were stained in gentian violet. The stratum corneum had become detached. In the superficial layers of the stratum Malpighii the cells were feebly stained and the nuclei often degenerate, but in its deeper layers the cells were deeply stained and appeared to be in a state of active proliferation. Here and there amongst the cells were some deeply stained granules, but none that I could recognise with confidence as micro-organisms. The corium showed marked infiltration with leucocytes.

The lung presented the ordinary characters of croupous pneumonia, the alveoli being full of leucocytes and red blood corpuscles, lying in the meshes of a well marked fibrin network. Here and there a few cocci were seen in the exudation.

The liver contained a large amount of yellowish brown pigment in clumps, mostly in the liver cells, which were otherwise normal. Those branches of the portal vein which came into the section were mostly thrombosed, and the clot contained enormous numbers of small micrococci, lying singly. In contact with the vessel wall they were clustered in a dense layer. Similar micrococci were scattered throughout the whole section. The condition appeared to be one of septic pylephlebitis, but I am of course unable to speak of the condition of any but the smaller branches of the portal vein which came into the sections.

The spleen was of normal texture. Here and there a few bacilli (of what species I cannot say) were scattered, either isolated or in groups of two or three. A few cocci were also seen. There was thus nothing distinctive to be found.

The kidney showed in places the ordinary changes of interstitial nephritis, not very far advanced; at the surface, beneath the capsule, were some patches of recently formed fibroid tissue. Baccilli were fairly numerous, small, short, and with rounded ends; I cannot say to what species they belonged. They were mostly scattered singly in and amongst the tubules and glomeruli, but in a few places there were large groups, in one case a cluster of several hundred. Very few, if any, micrococci could be found in the kidney sections.

Case VIII. George C., aged 49, admitted to the Paddington Infirmary for synovitis of the knee. He developed "epidemic eczema" and died after eight weeks. This case is M.XXV. of Dr. Savill's series. I have examined sections of the skin, spleen, and kidney.

The skin was cut in paraffin with a Cambridge rocking microtome, and the sections stained in gentian violet and methyl blue. They showed

much the same appearances as in the two preceding cases, a slight excess of leucocytes in the corium, and in the Malpighian layer, the cells for the most part faintly stained. The stratum corneum was absent, and no micro-organisms could be detected in the sections, except one or two cocci on the surface.

The spleen sections showed engorgement with blood, and much pigment from broken-up blood corpuscles was present amongst the splenic cells. Here and there bacilli were scattered through the sections, but of what species I cannot say.

The kidney sections showed the changes of advanced interstitial nephritis. Numerous bacilli were present, evidently not all of the same species. They were most abundant at the edge of the sections, which suggests that they were intrusive putrefactive organisms. Some, however, were present here and there in the central parts of the sections, even inside blood vessels, but these were not numerous. One or two stray cocci and diplococci were observed.

It will be seen that, in part, owing to the difficulty of procuring suitable material, the conclusions that can be drawn from the preceding observations are not decisive.

As regards the histological changes in the affected skin, I have been able, thanks to the fortunate opportunity for excising a fragment from the living patient in the very earliest stages, to observe them at a much earlier period than I believe has been hitherto done. These changes appear to be most marked in the deepest layer of the epidermis, rather than in the true skin, and to consist in a dropsical condition of the epidermic cells, which are separated by an intercellular exudation. I could find no indication at this stage of the exudation of fluid and leucocytes between the derma and epidermis seen by Dr. Savill, though the lymph spaces of the corium were manifestly distended in places with serum. In the sections of older skin taken at post-mortem examinations eight to twelve weeks from the commencement of the disease, the appearances were those of old inflammation, patches of brownish yellow pigment scattered through the corium and Malpighian layer, with an excess, not very marked, of leucocytes in the corium, and a tendency to proliferation of the deeper cells of the Malpighian layer such as might be expected to follow a protracted inflammation. The marked desquamative changes appeared to have their lower limit in the deepest cells of the stratum corneum, or in the stratum granulosum. In none of the cases examined at this late stage was there any indication of the casting off of any of the cells of the Malpighian layer, and in the very early case, desquamation had of course not commenced. I did not succeed in detecting any exudation of fluid between the derma and epidermis, whereby the latter was exfoliated, as seen by Dr. Savill, but I cannot speak of the intermediate stages, which I have had no opportunity of investigating. I have been unable to recognise, as regards microscopical characters, any essential differences between the morbid histology of "epidemic" and ordinary eczema, in spite of the dissimilarity which they undoubtedly exhibit in their clinical characters.

With reference to the existence of a specific micro-organism in the disease, it will be seen that my observations have so far yielded a negative result. If the malady is truly contagious it is eminently probably that the virus is a living organism. The fact that the onset is often localised and trivial, and is followed after a week or two by a generalised and symmetrical eruption, points to general infection of the blood in these cases. Yet the cultures made from the blood in my cases, as in most of those made by Dr. Risien Russell, have yielded no result,

or merely a growth of organisms well known as common inhabitants of the skin. I am not disposed to attach much importance to cultivations made from the superficial layers of desquamating skin. The normal flora of this tissue is not inconsiderable, and in diseased conditions is liable to be considerably augmented. The chief organism present in the one case in which I investigated this matter was staphylococcus epidermidis albus (Welch), a common organism in healthy skin, and perhaps only a slowly liquefying and feebly pathogenic variety of staphylococcus albus. I have not been able to compare my cultures with those obtained by Dr. Savill and Dr. Russell, so that I cannot state whether their microbe was the same as that which I found. Their descriptions, however, accord in most respects with Welch's description of his staphylococcus epidermidis albus. Another reason why I attach little importance to cultivation from skin flakes is the fact that the disease would appear to be primarily an inflammation of the deeper layers of the epidermis, which are not desquamated, and of the corium. Yet these layers, in practically all the cases which I investigated, I found to be free from micro-organisms, so far as the ordinary staining methods could show.

I am hence obliged to admit that, so far as my observations during the year 1893 are concerned, the results as to the demonstration of any specific micro-organism in "epidemic eczema" have been negative. The presence of cocci and bacilli in the internal organs in fatal cases (excluding the presence of accidental putrefactive organisms) though evidence of septic infection does not go far to show that such organisms are the primary cause of the skin disease, since the opportunities of septic infection are abundant in the extensive areas of raw and desquamating skin.

PLATE I.

Case XXI.

Bethnal Green Infirmary.

Case XXI.

William T——, aged 71.

Admitted into Infirmary 11th May 1893, the day of the appearance of the eruption. Has been an inmate of the Workhouse for the past seven and a half years, and at time of attack was acting as wardsman in Ward No. 26. Suffered from loss of appetite with furred tongue for a week or 10 days before appearance of eruption. This first showed itself on back of neck, then on forearms, legs, body, and face, rapidly developing into a general dermatitis, with muco-purulent conjunctivitis.

There was considerable œdema and thickening of skin of face, arms, and hands.

General desquamation followed, large flakes of epidermis peeling off hands and feet, leaving the skin red and tender.

By the 8th June the desquamation was complete, with the exception of a few scales on feet and hands.

On June 13th eruption *reappeared* in a distinctly papular form on both arms, and a few days later on the neck and chest. This attack ran a shorter course than the first; desquamation followed and patient recovered, the total duration of the disease having been about 10 weeks.

See Plate I.

BETHNAL GREEN INFIRMARY.

CASE XXIII.

John J——, aged 69.

Admitted into Infirmary on 15th May 1895. Had previously been in "the House." **Eruption** appeared on the 12th May on the forearms as a papuloerythematous rash, and rapidly spread up arms and over backs of hands, but was then not so well marked as on forearms. There were considerable induration of the skin, with much tingling and tenderness, but his general health did not suffer. Desquamation followed, and the patient recovered in about six weeks.

See Plate II.

PLATE II.

CASE XXIII.

PLATE III.

CASE XXV.

Bethnal Green Infirmary.

Case XXV.

William A——, Aged 67.

Admitted into the Infirmary on the 27th March 1893. Suffering from bronchitis. On the 12th May 1893 the eruption in an erythematous papular form appeared on the elbows and rapidly extended over the arms and back of hands, also, but in a slighter degree, over the abdomen. There was a good deal of thickening and induration of the skin, especially of the forearms, the large flat papules becoming considerably raised.

The patient's health did not suffer, but he was much troubled with itching and irritation of the skin; so severe at times as to prevent him sleeping. Desquamation followed, leaving the skin of the arms tender. The duration of the disease was about 10 weeks.

See Plate III.

Bethnal Green Infirmary.

Case XIII.

Mary F——, aged 58.

Admitted into Infirmary 21st January 1893. Suffering from suppurating wound of elbow. On 6th May 1893 eruption first appeared on the back and side of neck, then on forearms, afterwards on chest, abdomen, and legs, and, later on, on face and eyelids. It was at first papular, the papules being irregular in size and discrete. In a few days the papules became confluent forming irregular patches.

There was considerable irritation of skin, loss of appetite, and much thirst. Desquamation folowed, and the patient was discharged recovered on the 27th June 1893.

See Plate IV.

PLATE IV.

Case XIII.

PLATE V.

Case VI

Bethnal Green Infirmary.

Case VI.

George I——, aged 76.

This patient was admitted into the Infirmary on the 23rd December 1892, suffering from hemiplegia. Eruption appeared in a papular form on the 4th May 1893, and first showed itself on the forearms, then on the thighs and legs, but soon developed into a general dermatitis, the skin becoming shining and œdematous. Patient suffered from loss of appetite, sickness, and diarrhœa for about two weeks before appearance of eruption. General desquamation followed, the epidermis of feet, hands, and legs separating in large flakes. There was great prostration and exhaustion throughout the course of the disease, and the patient died from asthenia, on the 9th June 1893.

See Plate V.

App. A. No. II.

Extract from Professor Crookshank's Report to the Bethnal Green Guardians on Samples of Water and of Milk submitted to him for Bacteriological Examination, by Dr. Crookshank.

ADDENDUM A.

Extract from Professor Crookshank's Report to the Bethnal Green Guardians on Samples of Water and of Milk submitted to him for Bacteriological Examination.

I have the honour to report upon the bacteriological examination of the sample of water and three samples of milk received from you under the instructions of the Committee of your Board. I examined the sample of water from Bethnal Green, and found that one cubic centimetre contained 65 bacteria. The experiment was repeated in different ways, with the same result. The colonies were further examined by cultivation and microscopical examination, and only harmless microbes familiar to the experienced bacteriologist were found to be present, and from this examination I should entirely exonerate the water from being a cause of the epidemic, and indeed regard it as being exceptionally pure.

In the case of the milk samples, we get by the same methods very different results, but we must judge rather by the character of the microbes present than by their number. Milk constitutes a rich medium for the cultivation of micro-organisms, and if the milk be contaminated by bacteria from the air, or by bacteria from the udder of the cow or the hand of the milker, or by bacteria in the water used in washing the cans or other receptacles, or in the water added by dishonest dealers, then it will quickly undergo change from the rapid growth of these micro-organisms. Milk collected with all reasonable precaution contains about 500 bacteria to the cubic centimetre, but if care and cleanliness be disregarded the average number is 30,000, and if the milk be allowed to stand for some hours under favourable conditions of temperature, the numbers may increase to over *2,000,000*. The sample of milk (A.) contained 24,000 bacteria to the cubic centimetre, of which number *5,000* were bacteria which liquefied the gelatine.

The sample B., labelled Knifton, Duffield, 49, of the same date contained 98,000 bacteria to the cubic centimetre, of which 6,300 liquefied gelatine.

The sample C., labelled T. Smith, Rochester (379), contained 76,800 bacteria, of which 7,680 liquefied gelatine, and 840 of the mycelial fungus known as oidium lactis.

I failed to find by further examinations any microbes which are not commonly found in milk which has become contaminated with bacteria from the air, or from addition of water. I cannot, therefore, point to any micro-organism in the milk which could be held responsible for the epidemic in the infirmary. At the same time, judging from the samples submitted to me, I have no hesitation in condemning the milk-supply, and especially the sample C., labelled "Rochester."

In conclusion, I have only to refer to the one unavoidable objection to a bacteriological examination, viz., the time which must elapse before a report can be obtained. In studying these microscopic organisms we have to give them time to grow, and the rate of growth varies with different species; I have, however, recognised the urgency of the case, and pressed forward the examination of cultures, and the report thereon with all possible speed.

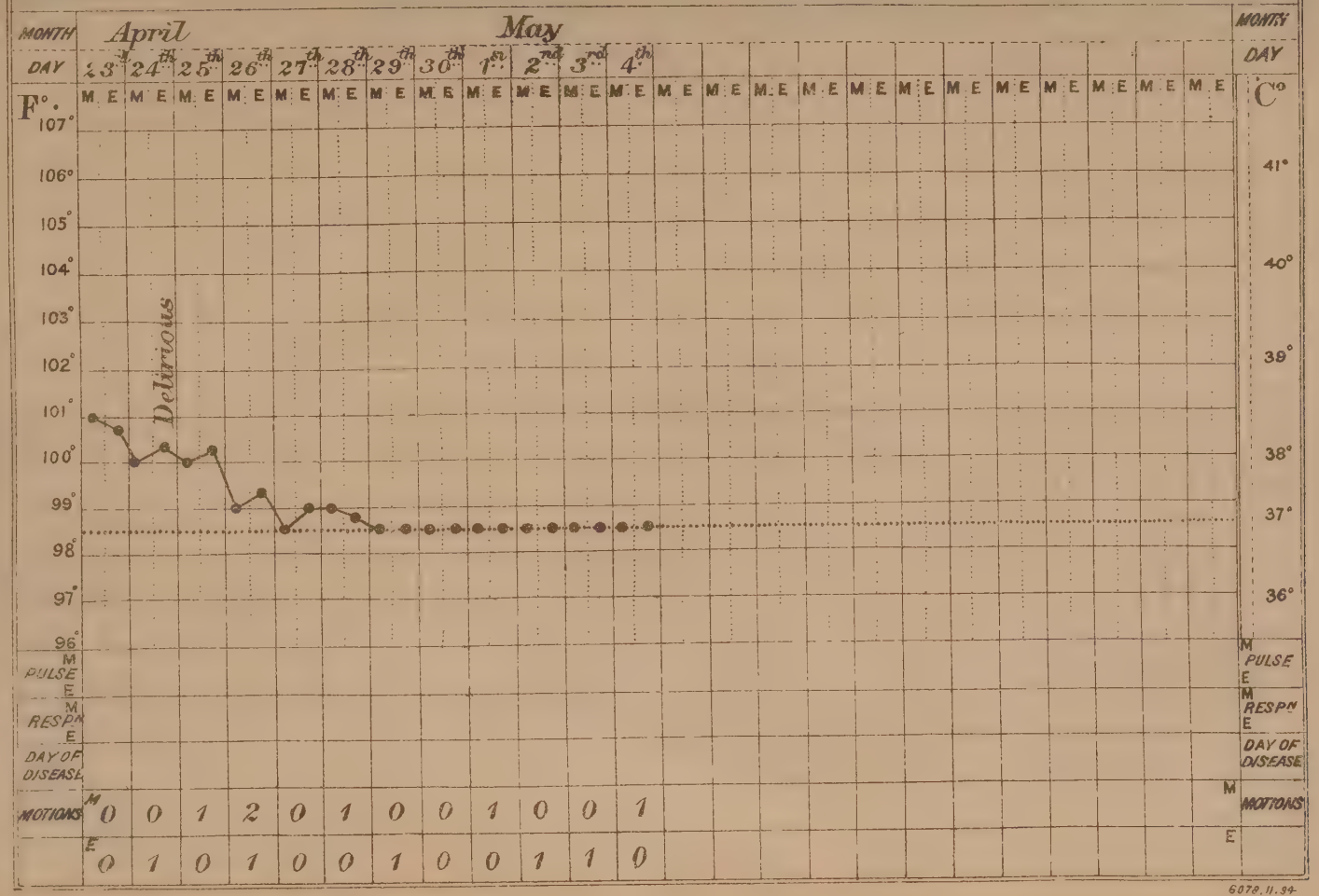
Professor Stokes' Analysis of a Sample of Milk received from the Bethnal Green Workhouse.

Sample marked:—"*T. Smith, Rochester, 910, 22nd May,* 93," and securely sealed with red wax bearing the impression of birds in a cornfield.

CITY OF LONDON INFIRMARY, BOW.

Temperature Chart, &c.

1893. *Julia V—.* *Age 72.*

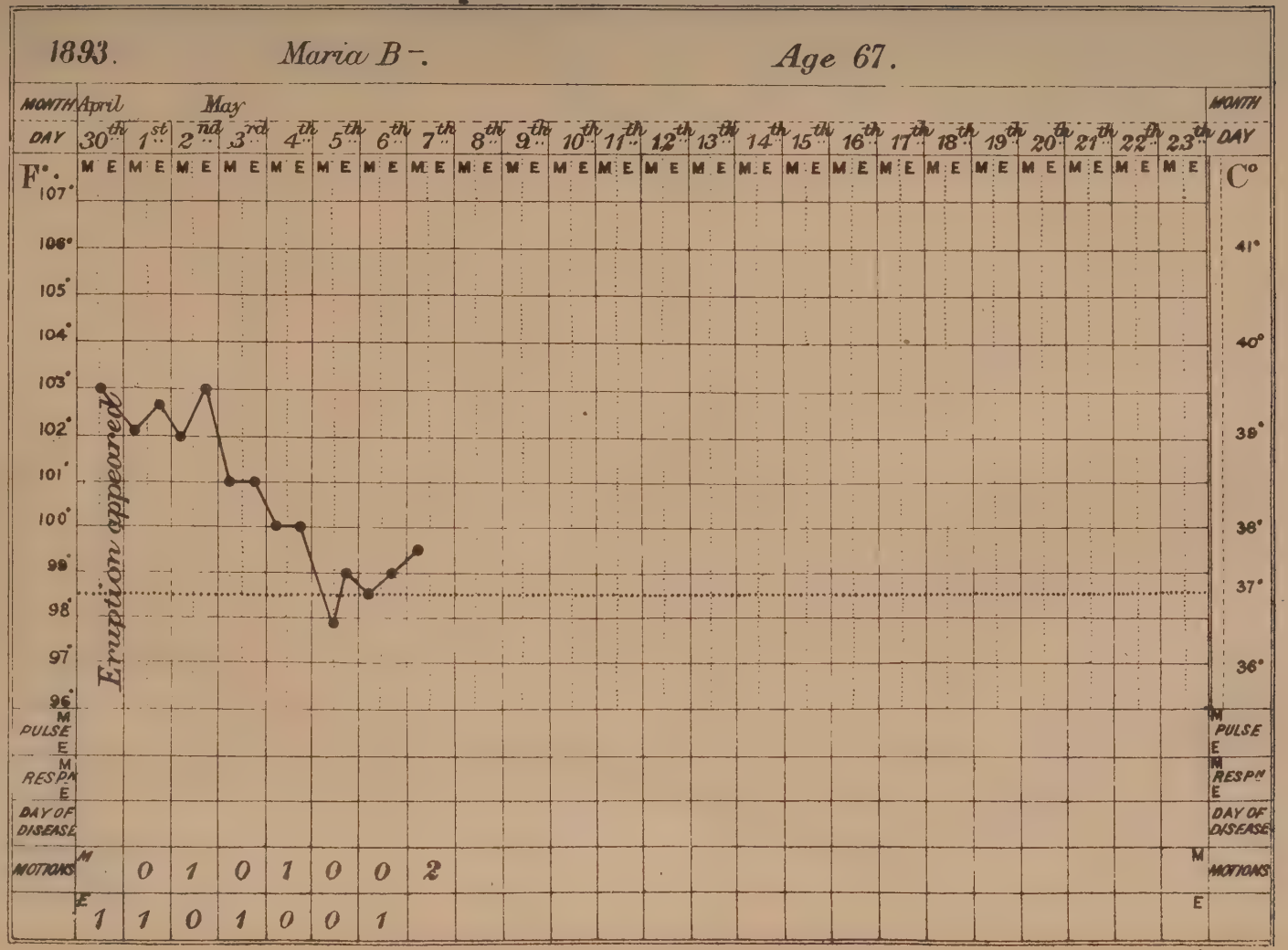


6078. 11. 94

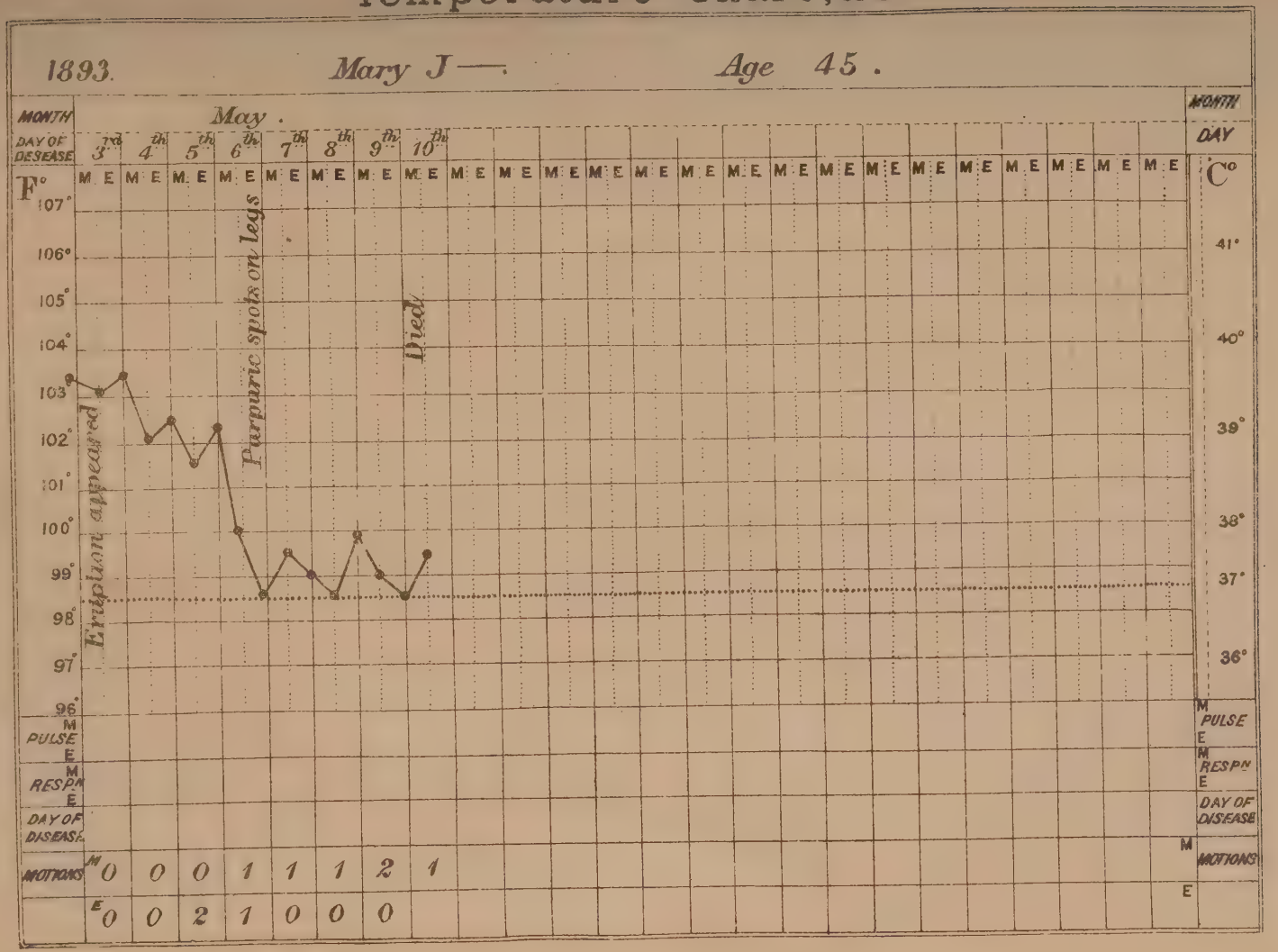
CITY OF LONDON INFIRMARY, BOW.

Temperature Chart, &c.

1893. Maria B—. Age 67.



Temperature Chart, &c.



Analytical Laboratory, Vestry Hall,
Paddington Green, W., May 25th, 1893.

Dear Sir,

I received from you for analysis, on May 24th, a sample of milk marked T. Smith, 910, &c. Having carefully examined this I find as follows:—

Condition when received: Quite sour.
Microscopical appearance: Fat globules broken.
Specific gravity: Could not be taken.

It contained in 100 parts by weight the following solid constituents:—

Total solid matters	7·17

consisting of—

Casein and milk-sugar	4·34
Fat or cream	1·78
Mineral salts	0·45

Hence, after taking into consideration the above facts, I am of opinion that this contains 60 per cent. of added water, that it had been deprived of 30 per cent. of its cream, and has had a quantity of borax added to it as a preservative. It is the worst sample I have ever met with.

Yours faithfully,

Alf. W. Stokes, F.C.S., F.I.C.
(Public Analyst.)

Mr. R. L. Sturkevant,
Bethnal Green Workhouse.

ADDENDUM B.

PARTICULARS as to CASES of EPIDEMIC SKIN DISEASE occurring in the BETHNAL GREEN INFIRMARY.

No. of Ward in which Patient was when Eruption appeared	Name of Patient.	Age	Date of Admission to Sick Ward.	Date of Appearance of Eruption.	Date of Removal to other Wards.	No. of Ward to which removed.	Diet of Patient at Time of Appearance of Eruption.	Amount of Milk which Patient was having when Eruption appeared.	Previous Malady from which Patient was suffering.	General Condition of Patient previous to Attack.	—
								Pints.			
2	C., John	54	31.9.92	4.5.93	13.5.93	28	5, mutton broth, eggs.	½	Bronchitis	Fair, up daily.	
	C., Charles	58	8.5.93	9.5.93	13.5.93	28	4, eggs	2	None	In good health	Working in kitchen till admission to infirmary.
	B., Henry	82	24.2.92	10.5.93	13.5.93	28	5, fish, rice	½	Senile decay	In good health.	
	L., Henry	87	3.5.92	12.5.93	17.5.93	41	3, rice, egg	½	Senile decay	Confined to bed.	
	B., Henry	72	26.6.84	13.5.93	Not removed		3, rice, 2 eggs	½	Rheumatic arthritis	Confined to bed	Died 28th May 1893.
	H., William	54	11.5.93	21.5.93	Not removed		4	2	Injury to eye	In good health.	
	W., George	70	24.9.90	30.5.93	30.5.93	27	3, rice	½	Ulcer of leg	In good health.	
5	J., John	69	15.5.93	12.5.93	23.5.93	38	3, pint milk	1½	None	In good health	Wardsman. No. 5 Ward. Sleeping in 4, front door not to "become" till 15th May 1893. At first kept on 5 Ward. No other case in this ward
8	S., Sarah	80	14.3.92	20.5.93	Not removed		4	2	Senile dementia	Confined to bed.	
	T., Jane	82	24.3.92	21.5.93	Not removed		4	2	Senile dementia	Confined to bed.	
9	B., Elizabeth	83	15.7.92	5.5.93	20.5.93	8	3	½	Senile dementia	In good health.	
12	S., Harriet	60	15.9.90	15.5.93	Not removed		5, fish	½	Epilepsy	In good health.	
	M., Susan	72	18.6.92	17.5.93	Not removed		3	½	Epilepsy	In good health.	
	E., Emma	41	25.1.93	19.5.93	Not removed		3	½	None	In good health.	
	A., Amy	66	2.1.84	27.5.93	Not removed		3	½	Epilepsy	In good health.	
15	L., Mary Ann	37	21.4.93	4.5.93	30.5.93	22	5, fish, pint milk	1½	Acute rheumatism	Convalescent, but continued to bed.	
	S., Mary Ann	67	24.3.93	24.5.93	30.5.93	22	3, pint milk, egg	1½	Gangrene of toes	Confined to bed.	
	N., Elizabeth Jane	52	6.2.93	27.5.93	30.5.93	22	3, pint milk, egg	1½	Rheumatic gout	Good health, up daily.	

No. of Ward in which Patient was when Eruption appeared.	Name of Patient.	Age	Date of Admission to Sick Ward.	Date of Appearance of ruption.	Date of Removal to other Wards.	No. of Ward to which removed.	Diet of Patient at Time of Appearance of Eruption.	Amount of Milk which Patient was having when Eruption appeared.	Previous Malady from which Patient was suffering.	General Condition of Patient previous to Attack.	—
								Pints.			
	H., Elizabeth -	38	15.5.93	15.5.93	30.5.93	22	3, pint milk -	1½	None - -	In good health -	Admitted to house 5th August 1892. Attacked whilst acting as kitchen woman to Nurse 3, who has charge of 14, 15, 16, 17, 18, and 19 Wards. Sent to 15 Ward 24th May, and to 22 Ward 30th May 1893.
17	H., Elizabeth -	82	8.10.92	30.5.93	30.5.93	22	3 - - -	½	Hemiplegia - -	Feeble, confined to bed.	
	G., Mary - -	85	10.7.90	1.6.93	1.6.93	24	3, pint milk, egg	1½	Senile decay -	Confined to bed.	
18	F., Mary - -	58	21.1.93	6.5.93	30.5.93	22	5, chop, egg, pint milk.	1½	Lacerated elbow -	Health good, up daily.	Was discharged, recovered, to her home, 17th June 1893.
14 f.	D., Caroline -	73	13.6.92	10.5.93	30.5.93	22	3 - - -	½	Carcinoma of breast	Health fair, up daily.	
20 m.	D., George -	89	2.3.92	1.6.93	1.6.93	27	5, mutton broth	½	Senile decay - -	Health good, up daily.	
20 f.	A., Jane - -	43	16.8.92	12.5.93	17.5.93	22	4, egg - -	2	Aortic disease -	Confined to bed.	
	W., Sarah -	45	19.4.93	15.5.93	17.5.93	22	4 - - -	2	Sub-acute rheumatism.	Up daily.	
	S., Mary A. -	34	24.4.93	17.5.93	17.5.93	22	4 - -	2	Chronic bronchitis -	Up daily.	
21 f.	R., Elizabeth -	77	16.12.92	15.5.93	17.5.93	22	5, mutton broth, egg, pint milk.	1½	Bronchitis - -	Confined to bed.	
	W., Louisa -	52	8.3.92	30.5.93	30.5.93	22	, beef tea -	½	Myxoedema - -	Health fair, up daily.	
21 a.f.	H., Charlotte -	84	13.10.92	14.5.93	30.5.93	24	4, 2 eggs -	-	Senile decay -	Feeble, confined to bed.	Died 13th June 1893.
	B., Elizabeth -	73	17.12.92	22.5.93	30.5.93	24	5, fish, egg -	-	Bronchitis - -	Health fair, up daily.	
22 f.	H., Mary A. -	84	5.11.92	12.5.93	Not removed -		4, fish and beef tea, 2 eggs, pint milk.	3	Chronic bronchitis -	Health fair, up each day.	
	S., Ellen - -	36	2.11.92	14.5.93	Not removed -		4 - -	2	Phthisis - -	Confined to bed.	
	P., Harriet -	52	20.3.93	14.5.93	Not removed -		5, mutton broth, pint milk.	1½	Ulcer of leg - -	In good health.	

No. of Ward in which Patient was when Eruption appeared	Name of Patient.	Age	Date of Admission to Sick Ward.	Date of Appearance of Eruption.	Date of Removal to other Wards.	No. of Ward to which removed.	Diet of Patient at Time of Appearance of Eruption.	Amount of Milk which Patient was having when Eruption appeared.	Previous Malady from which Patient was suffering.	General Condition of Patient previous to Attack.	
								Pints.			
	S., Elizabeth	22	30.1.93	16.5.93	Not removed		5, fish, 2 eggs, 2 pints milk.	2½	Ulcers of leg	In good health, but in bed.	
	H. Isabella	74	22.9.92	20.5.93	Not removed		5, fish, rice	½	Hemiplegia	Confined to bed, health good.	
	W., Elizabeth	76	10.5.93	21.5.93	Not removed		3	½	Cystitis	Confined to bed, health good.	
	M., M. A.	83	8.11.92	22.5.93	Not removed		5, beef tea	½	Rheumatic arthritis	Health fair, but confined to bed.	
22 s.f.	E., Mary Ann	26	28.4.86	22.5.93	23.5.93	24	3	½	Rheumatic arthritis	Feeble, confined to bed	
	S., Mary	22	21.4.93	24.5.93	25.5.93	23, a single room.	4, pint milk	3	Typhoid fever	Convalescent.	
23 f.	W., Charlotte	56	11.4.93	10.6.93	10.6.93	24	5, beef tea	½	Acute nephritis	Confined to bed.	
23 a f	C., Charlotte	84	24.10.90	4.5.93	Not removed		4, 2 eggs	2	Senile decay	Confined to bed	Died 23rd May 1893.
24 m.	D., John	62	12.12.92	19.5.93	20.5.93	28	3	½	Ulcer of leg	Health good.	
24 f.	H., Ann	72	2.11.92	7.5.93	Not removed		5, fish, egg	½	Chronic bronchitis	Able to be up daily.	
	P., Lucy	69	9.9.92	8.5.93	Not removed		4, egg	2	Hemiplegia	Confined to bed, but health good.	
	M., Frances	14	11.2.93	18.5.93	Not removed		5, mutton broth, egg	½	Abscess of neck	Health fair, up daily.	
	G., Margaret	81	20.3.92	18.5.93	Not removed		3, egg	½			
	H., Mary Ann	85	30.12.92	24.5.93	Not removed		4, egg	2	Senile decay	Confined to bed.	
	P., Henry	41	28.8.92	17.5.93	18.5.93	28	5, chop	½	Phthisis	Up daily.	
25 m.	S., Henry	79	24.9.92	20.5.93	20.5.93	27	5, fish, egg	½	Dementia	Confined to bed.	
25 f.	J., Ellen	56	5.8.89	12.5.93	13.5.93	24	5, fish	½	Ulcer of leg	In good health.	
	G., Elizabeth	77	31.1.93	21.5.93	22.5.93	24	3, egg	½	Chronic bronchitis	Up part of day	
	P., Louisa	20	16.5.93	21.5.93	Not removed		4, 2 eggs	2	Phthisis	Haemoptysis, confined to bed.	

No. of Ward in which Patient was when Eruption appeared.	Name of Patient.	Age	Date of Admission to Sick Ward.	Date of Appearance of Eruption.	Date of Removal to other Wards.	No. of Ward to which removed.	Diet of Patient at Time of Appearance of Eruption.	Amount of Milk which Patient was having when Eruption appeared.	Previous Malady from which Patient was suffering.	General Condition of Patient previous to Attack.	—
								Pints.			
26	T., William	71	11.5.93	11.5.93	13.5.93	28	3 - - - -	½	None - - -	In good health -	Wardsman, 26 Ward. Admitted house 18th September 1885. Sleeping No. 1 front dormitory, "house."
	R., Henry -	77	1.5.93	11.5.93	13.5.93	28	3, pint milk -	1½	Dementia - -	Confined to bed.	
	A., John -	66	23.8.92	22.5.93	23.5.93	27	3, 2 pints milk, rice.	3½	Hemiplegia - -	In good health, but confined to bed.	
	P., John -	56	4.1.93	25.5.93	26.5.93	27	5, chop, pint milk	1½	Rheumatic arthritis	Confined to bed, general health good.	
27	I., George -	76	23.12.92	4.5.93	13.5.93	28	3, pint milk, egg	1½	Hemiplegia - -	Confined to bed -	Died 9th June 1893.
31	H., John - -	43	22.4.93	8.5.93	13.5.93	28	5, mutton broth, pint milk.	1½	Acute gout - -	Otherwise in good health.	
	O., James -	52	7.3.93	15.5.93	16.5.93	40	3 - - -	½	Hemiplegia - -	In good health.	
33	C., Hammond -	83	21.3.92	5.5.93	17.5.93	41	5, mutton broth, 2 eggs, rice.	½	Senile decay - -	Feeble, confined to bed.	
	B., Edward -	78	1.10.92	19.5.93	19.5.93	41	5, fish, egg -	½	Chronic bronchitis -	Up daily, health fair	
34	F., James - -	76	23.4.92	4.5.93	13.5.93	28	3, rice - -	½	Hemiplegia - -	Health good.	
	S., Joseph -	40	12.5.93	9.5.93	12.5.93	28	3 - - - -	½	None - - -	Health good - -	Wardsman in 34 Ward. Rash observed by patient 9th May 1893, but not shown to Medical Officer till 12th May 1893.
	W., George -	68	14.10.92	12.5.93	13.5.93	41	3 - - - -	½	Rheumatic gout -	Otherwise in good health.	
35	S., George - -	52	10.4.93	19.5.93	19.5.93	41	3, 2 eggs, 2 pints milk.	2½	Acute bronchitis -	Convalescent, but unable to be up.	
	B., William -	68	31.1.93	22.5.93	23.5.93	41	5, fish, rice -	½	Chronic bronchitis -	Confined to bed.	
	H., Philip -	75	15.5.93	2.6.93	2.6.93	40	5, fish, egg - -	½	Acute gout - -	Confined to bed, thin, delicate.	
36	W., Edward -	63	15.12.92	23.5.93	24.5.93	38	5, fish, 2 eggs, pint milk.	1½	Phthisis - -	Able to be up daily.	
	B., James -	64	10.9.91	27.5.93	28.5.93	38	5, fish, egg, pint milk.	1½	Chronic bronchitis -	Confined to bed.	
37	A., William -	67	27.3.93	12.5.93	13.5.93	38	3, egg, pint milk	1½	Chronic bronchitis -	Up daily.	
38	A., William -	73	14.2.93	4.5.93	Not removed -		4, 2 eggs - -	2	Cardiac - - -	Up daily - -	Died 21st May 1893.
	P., William -	74	1.3.93	4.5.93	Not removed -		3 - - -	½	Chronic rheumatism	Confined to bed.	
	C., Richard -	44	15.12.92	12.5.93	13.5.93	28	3, rice, egg - -	½	Pneumonia - -	Up daily.	

No. of Ward in which Patient was when Eruption appeared.	Name of Patient.	Age.	Date of Admission to Sick Ward.	Date of Appearance of Eruption.	Date of Removal to other Wards.	No. of Ward to which removed.	Diet of Patient at Time of Appearance of Eruption.	Amount of Milk which Patient was having when Eruption appeared.	Previous Malady from which Patient was suffering.	General Condition of Patient previous to Attack.	—
								Pints.			
	A., Joseph	82	24.5.93	16.5.93	Not removed		3	½	Old age	Up daily. In fair health.	
39	G., Alfred	58	15.2.93	25.5.93	26.5.93	38	5, fish	½	Gout	In good health.	
40	S., John	42	31.3.93	5.5.93	17.5.93	41	3, 2 pints milk	2½	Ulcer	In good health.	
	C., James	68	25.4.92	21.5.93	Not removed		3	½	Ulcer of leg	In good health.	
	F., Augustus	82	28.6.92	24.5.93	Not removed		3, pint milk, egg	1½	Old age, cystitis	Confined to bed.	
41	B., William	89	17.2.93	12.5.93	Not removed		5, mutton broth	½	Hemiplegia	Confined to bed, but health good.	
48	V., James	82	8.10.90	5.5.93	30.5.93	37	3	½	Old age, hernia	Health good, up daily.	
	S., Page	67	12.2.92	15.5.93	17.5.93	40	3, rice	½	Rheumatism	Health good, up part of day.	
	W., James	83	7.3.93	2.5.93	2.5.93	40	5, fish, egg	½	Chronic bronchitis	Confined to bed.	
"House."	L., Alfred	43	23.5.93	5.5.93	23.5.93	36	3	1	None	In good health	Admitted to workhouse 29th Oct. 1892. Working in large kitchen till 23rd May, when discovered by Medical Officer. Date of appearance fixed from own statement.
	H., Arthur	24	30.5.93	-		40	3, egg, pint milk before discharge.	1	-	-	Says he has been sleeping at Salvation Army shelter in Queen Street for past four weeks. Eruption on body for past month; appeared first on chest.
	F., James	68	5.5.93	-		40	Says living badly at home.	1½	Prolapsus ani	In fair health	Discharged from 2nd Ward 5th May 1893. Eruption appeared about a week afterwards. On road to-day 3rd June was shut out on arms and chest.

JOHN KNOX.

Table showing the Number of Persons and of Cases of Epidemic Skin Disease at each of Certain Age Periods in the Infirmary during May and June 1893. (Calculated on Number of Patients in Infirmary on May 4th, 1893, date of Commencement of Epidemic.)

Age.	1–9.		10–19.		0–29.		30–39.		40–49.		50–59.		60–69.		70–79.		80–89.		Totals at all Ages.	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
Number of persons under treatment at each age -	7	6	6	9	15	19	18	15	39	21	34	22	62	39	40	49	23	38	244	218
Number of cases affected with the epidemic skin disease - - -	0	0	0	1	1	4	0	5	7	4	6	6	11	2	11	7	9	12	45	41
Ratio of cases of the disease to inmates of Infirmary at each age; per cent. - - -	0	0	0	11·11	6·66	21·05	0	33·33	17·94	19·04	17·64	27·27	17·74	5·12	27·50	14·28	39·13	31·57	18·44	18·80
Proportion attacked in both sexes combined; per cent. - - -	0 out of 13.		1 out of 15, =6·66 %.		5 out of 34, =14·70 %.		5 out of 33, =15·15 %.		11 out of 60, =18·33 %.		12 out of 56, =21·42 %.		13 out of 101, =12·87 %.		18 out of 89, =20·22 %.		21 out of 61, =34·42 %.		86 out of 462, =18·61 %.	

App. A. No. II.

Drawn [illegible] by Dr. Copeman.

Bethnal Green Infirmary.

Names of those Attacked in Order of Appearance of Eruption.

1	A., William -	4.5.93	44	S., M. A. - -	17.5.93
2	P., William -	4.5.93	45	M., Susan - -	17.5.93
3	L., Mary Ann -	4.5.93	46	P., Henry -	17.5.93
4	C., Charlotte -	4.5.93	47	M., Frances -	18.5.93
5	C., John - -	4.5.93	48	G., Margaret -	18.5.93
6	L., George - -	4.5.93	49	D., John - -	19.5.93
7	F., James -	4.5.93	50	S., George -	19.5.93
8	S., John - -	5.5.93	51	B., Edward -	19.5.93
9	V., James - -	5.5.93	52	E., Emma - -	19.5.93
10	B., Elizabeth -	5.5.93	53	H., Isabel -	20.5.93
11	L., Alfred - -	5.5.93	54	S., Sarah - -	20.5.93
12	C., Hammond -	5.5.93	55	T., Jane - -	21.5.93
13	F., Mary - -	6.5.93	56	S., William -	21.5.93
14	H., Ann - -	7.5.93	57	W., Elizabeth -	21.5.93
15	P., Lucy - -	8.5.93	58	F., Louisa - -	21.5.93
16	H., John - -	8.5.93	59	G., Elizabeth -	21.5.93
17	C., Charles -	9.5.93	60	C., James -	21.5.93
18	S., Joseph - -	9.5.93	61	A., John - -	22.5.93
19	B., Henry -	10.5.93	62	B., Elizabeth -	22.5.93
20	D., Caroline -	10.5.93	63	E., M. A. -	22.5.93
21	T., William -	11.5.93	64	M., M. A. - -	22.5.93
22	R., Henry - -	11.5.93	65	B., William -	22.5.93
23	J., John - -	12.5.93	66	W., Edward -	23.5.93
24	L., Henry -	12.5.93	67	F., Augustus -	24.5.93
25	A., William -	12.5.93	68	B., Mary Ann -	24.5.93
26	A., Jane - -	12.5.93	69	S., Martha -	24.5.93
27	W., George -	12.5.93	70	S., Mary - -	24.5.93
28	B., William - -	12.5.93	71	P., John - -	25.5.93
29	C., Robert -	12.5.93	72	G., Alfred -	25.5.93
30	H., Mary - -	12.5.93	73	M., Elizabeth -	27.5.93
31	M., Ellen - -	12.5.93	74	A., Mary - -	27.5.93
32	B., Henry -	13.5.93	75	B., James - -	27.5.93
33	S., Harriet - -	13.5.93	76	H., Elizabeth -	30.5.93
34	H., Charlotte -	14.5.93	77	S., Henry -	30.5.93
35	S., Ellen - -	14.5.93	78	W., Louisa -	30.5.93
36	P., Harriet - -	14.5.93	79	W., George -	30.5.93
37	H., Elizabeth -	15.5.93	80	G., Mary - -	1.6.93
38	O., James - -	15.5.93	81	D., George -	1.6.93
39	S., Page - -	15.5.93	82	H., Arthur -	—
40	W., Susan - -	15.5.93	83	H., Philip - -	2.6.93
41	R., Elizabeth -	15.5.93	84	W., James -	2.6.93
42	A., James -	16.5.93	85	F., James -	—
43	S., Elizabeth -	16.5.93	86	W., Charlotte -	10.6.93

Bethnal Green Workhouse.

Table showing the frequency with which various Parts of the Body were first affected.

Parts first attacked by Skin Disease.	Males.	Females.	Total.	Per cent.
Wrists and forearms	24	20	44	51·16
Upper arm	0	0	0	0·00
Face and scalp	7	6	13	15·11
Feet and legs	2	2	4	4·65
Thighs and groins	2	1	3	3·48
Hands	1	2	3	3·48
Back	0	0	0	0·00
Neck	6	6	12	13·95
Chest and abdomen	3	4	7	8·13
Ears	0	0	0	0·00
	45	41	86	100·00

Bethnal Green Workhouse Infirmary.

Diet of Patients attacked with Epidemic Skin Disease.

	On the 24th April 1893.	On the 4th May 1893.	On the 4th June 1893.
Total number having meat daily	45	42	29
" " fish daily	15	18	24
" " mutton broth daily	6	7	14
" " beef tea daily	15	16	14
" " eggs alone	0	0	1
" " scalded milk alone daily	9	12	5
" " scalded milk and cold daily	16	14	1
" " cold milk daily	72	71	77
" " extra milk daily	28	26	12
" " milk daily	81	83	82
" " eggs, in addition to meat, daily	12	11	10
" " eggs, in addition to fish, daily	11	10	20
" " eggs, in addition to mutton broth, daily	3	4	7
" " eggs, in addition to beef tea, daily	6	9	10
" " eggs daily	32	34	47
" " rice daily	27	27	21
Total number suffering from disease	81	83	82

	Males.	Females.	Total.
Total number attacked by said disease	45	41	86

—	Males.	Females.	Total.
Total number of sick inmates on 24th April 1893	252	230	482
Number admitted from 24th April till 10th June 1893 inclusive - - - -	202	152	354
	454	382	836

Bethnal Green Workhouse.

Number of Inmates in Workhouse and Infirmary and the Diets of the Patients in the Infirmary.

—	On the 24th April 1893.	On the 4th May 1893.	On the 4th June 1893.
Total number of inmates in workhouse -	1,321	1,326	1,304
" " sick in infirmary - -	482	462	454
" " " having meat daily -	255	249	214
" " " fish daily - -	92	85	92
" " " mutton broth daily -	42	46	51
" " " beef tea daily -	90	79	92
" " " eggs alone daily -	8	8	5
" " " scalded milk only daily - -	47	55	49
" " " scalded milk and cold milk - -	88	88	58
" " " cold milk daily -	435	429	399
" " " extra milk daily, cold	159	154	86
" " " milk daily - -	482	462	454
" " " eggs, in addition to meat, daily -	75	70	49
" " " eggs, in addition to fish, daily - -	85	46	58
" " " eggs, in addition to mutton broth, daily	26	35	27
" " " eggs, in addition to beef tea, daily -	43	38	43
" " " eggs, daily - -	202	192	187
" " " rice daily - -	170	158	123

Dietary Table of the Bethnal Green Workhouse.

Able-bodied.	Breakfast.		Dinner.					Supper.			
	Bread.	Oatmeal Gruel.	Cooked Meat.	Potatoes or other Vegetables.	Bread.	Pea Soup.	Suet Pudding.	Bread.	Broth.	Cheese.	Tea.
	Ozs.	Pints.	Ozs.	Ozs.	Ozs.	Pints.	Ozs.	Ozs.	Pints.	Ozs.	Pints.
Sunday - Men	6	1½	5	8	—	—	—	6	1½	—	—
Women	5	1½	5	8	—	—	—	5	1½	—	—
Monday - Men	6	1½	—	—	—	—	14	6	—	2	1
Women	5	1½	—	—	—	—	12	5	—	2	1
Tuesday - Men	6	1½	5	8	—	—	—	6	1½	—	—
Women	5	1½	5	8	—	—	—	5	1½	—	—
Wednesday - Men	6	1½	—	—	4	1½	—	6	—	2	1
Women	5	1½	—	—	4	1½	—	5	—	2	1
Thursday - Men	6	1½	5	8	—	—	—	6	1½	—	—
Women	5	1½	5	8	—	—	—	5	1½	—	—
Friday - Men	6	1½	—	—	—	—	14	6	—	2	1
Women	5	1½	—	—	—	—	12	5	—	2	1
Saturday - Men	6	1½	—	—	4	1½	—	6	—	2	1
Women	5	1½	—	—	4	1½	—	5	—	2	1

Aged and Infirm.		Breakfast.			Dinner.					Supper		
		Bread.	Butter.	Tea sweetened with half an ounce of Sugar to each Pint.	Cooked Meat.	Potatoes or other Vegetables.	Bread.	Pea Soup.	Suet Pudding.	Bread.	Butter.	Tea sweetened with half an ounce of Sugar to each Pint.
		Ozs.	Oz.	Pint.	Ozs.	Ozs.	Ozs.	Pint.	Ozs.	Ozs.	Oz.	Pint.
Sunday	Men	6	¾	1	5	8	—	—	—	6	¾	1
	Women	5	¾	1	5	8	—	—	—	5	¾	1
Monday	Men	6	¾	1	—	—	—	—	14	6	¾	1
	Women	5	¾	1	—	—	—	—	12	5	¾	1
Tuesday	Men	6	¾	1	5	8	—	—	—	6	¾	1
	Women	5	¾	1	5	8	—	—	—	5	¾	1
Wednesday	Men	6	¾	1	—	—	4	1½	—	6	¾	1
	Women	5	¾	1	—	—	4	1½	—	5	¾	1
Thursday	Men	6	¾	1	5	8	—	—	—	6	¾	1
	Women	5	¾	1	5	8	—	—	—	5	¾	1
Friday	Men	6	¾	1	—	—	—	—	14	6	¾	1
	Women	5	¾	1	—	—	—	—	12	5	¾	1
Saturday	Men	6	¾	1	—	—	4	1½	—	6	¾	1
	Women	5	¾	1	—	—	4	1½	—	5	¾	1

Bethnal Green Workhouse Infirmary.

Dietary for Sick Paupers.*

No. 1 House diet, being the ordinary diet for paupers in the house.

No. 2.		Breakfast.			Dinner.						Supper.				
		Bread.	Tea.	Butter.	Cooked Meat, without Bone.		Potatoes or Bread.		Milk, not ordinarily boiled, except in hot Weather.		Bread.	Tea.	Butter.	Milk.	
2	Full diet														
		Ozs.	Pts.	Oz.	Ozs.	Pts.	Ozs.	Ozs.	Pts.		Ozs.	Pts.	Oz.		
2	Males	6	1	$\frac{1}{3}$	5		8	6	1	Cold.	6	1	$\frac{1}{2}$		
2	Females	5	1	$\frac{1}{2}$	5		8	5	1		5	1	$\frac{1}{2}$		

No. 3.		Breakfast.			Dinner.					Supper.				
		Bread.	Tea.	Butter.	Cooked Meat, without Bone.		Potatoes or Bread.		Milk.	Bread.	Tea.	Butter.		
3	Low diet													
	Rice and milk frequently; this diet at 11 a.m.	Ozs.	Pts. 1 pint of milk to 1 gallon of tea.	Oz.	Ozs.		Ozs.	Ozs.	Pt.	Ozs.	Pts.	Oz.		
3	Males	5		$\frac{1}{2}$	5		8	6	$\frac{1}{2}$	Cold always.	5	1	$\frac{1}{2}$		
3	Females	4		$\frac{1}{2}$	5		8	5	$\frac{1}{2}$		4	1	$\frac{1}{2}$		

* If thought proper by the medical officer, an additional number of dietaries may be introduced, and numbered consecutively.

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No. 4.		Breakfast.				Dinner.						Supper.				
4	Fever diet -	Bread	Milk, Hot.	Butter	Tea		Beef Tea.	Bread.	Rice with Milk.			Bread.	Milk, Hot.	Sago.	Butter.	Tea.
		Ozs.	Pts.	Oz.	Pts.	Ozs.	Pts.	Ozs.	Ozs.			Ozs.	Pts.	Pts.	Ozs	Pts.
4	Males -	3	1				1	3	8			3	1			
4	Females -	3	1				1	3	8			3	1			
											No. 5 Diet.					
5	Males -	5		½	1					½	The dinners are ordered by the medical officers.	5			½	1
5	Females -	4		½	1					½	With fish or chop, 8 ozs potatoes or bread. Fish with 4 and 5 diets.	4			½	1
											With beef tea, 5 ozs bread for males and 4 ozs for females					
											With mutton broth, 5 ozs bread for male and 4 ozs for females					
											With eggs, 5 ozs bread for males and 4 ozs. for females, and ½ oz butter each.					

N. B.—Sugar, arrowroot, sago, butter, milk, wine, spirits, porter, and beer are in all cases to be treated as extras, to be expressly ordered when required, and the quantity is to be then specified in the proper column of this book.

Where meat is stated—Mutton, six days; beef on Sundays.

INFIRMARY. CITY OF LONDON UNION.

Sick Dietaries.

—	—	Breakfast, 7 a.m.	Dinner, 12 p.m.	Supper, 5 p.m.
No. 1. Ordinary diet	Men and women	5 oz. bread and butter, 1 pint tea.	Sunday, Tuesday, Wednesday, Thursday, and Saturday. 5 oz. cooked meat. 8 oz. potatoes or vegetables. Monday and Friday. 1 pint soup. 4 oz. bread.	5 oz. bread and butter. 1 pint tea.
No. 2. Full diet	Men and women	4 oz. bread and butter. 1 pint tea.	5 oz. cooked mutton. 8 oz. potatoes or vegetables.	5 oz. bread and butter. 1 pint tea.
No. 3. Low diet	Men and women	4 oz. bread and butter. 1 pint tea.	4 oz. cooked mutton or ½ pint broth or beef tea. 4 oz. bread.	4 oz. bread and butter. 1 pint tea.
No. 4. Milk diet	Men and women	2 oz. bread and butter. ½ pint milk stewed.	12 oz. rice pudding. 2 oz. bread	2 oz. bread and butter. ½ pint milk stewed.

Children under 3 years of age, 4 diet; above 3 years of age, 3 diet.

NOTE.—All articles of diet not mentioned in the dietary, as also stimulants, fruit, and other extras, are to be ordered by the medical officer when required, and the quantities so ordered are to be entered in the medical relief book.

The meat to be baked or minced when ordered. Beef, meat pie, or bacon, to be substituted for mutton, at the discretion of the medical officer.

Quantities used in each pint of articles named in the dietary.

Soup: 3 oz. peas or rice, 6 oz. meat and bone in the liquor in which meat has been boiled. Beef tea: 8 oz meat, without bone, to each pint. Broth: 8 oz. meat to each pint, the meal to be served with the broth. Rice pudding: 2 oz. rice, ½ oz. sugar, 1 egg, ½ pint milk. Gruel: 4 oz. oatmeal, 2 oz. milk to each pint. Tea: ¼ oz. tea, ½ oz. sugar, 2 oz. milk to each pint. Cocoa: ½ oz. cocoa, ½ oz. sugar, 2 oz. milk, to each pint.

C. H. BUNCOMBE, Medical Officer,
25th March 1893.

This form approved, 14th February 1893.
F. W. CRANE, Clerk.
Order No. 107

APP. A. No. 11.
On an Outbreak of Epidemic Skin Disease; by Dr. Copeman.

II.—INFIRMARY OF ST. LEONARD'S, SHOREDITCH.

While my report on the outbreak of epidemic skin disease at Bethnal Green Infirmary was passing through the press, I learnt, through Dr. Downes, that two or three cases of what appeared to be the same affection had recently come under treatment at the Infirmary of St. Leonard's Workhouse, Shoreditch.

Accordingly, early in May 1894, I visited the Infirmary for the purposes of investigating the local circumstances of the outbreak. The Medical Superintendent (Mr. Forbes) informed me that the disease had first been noticed in the case of a patient named William W——, 59 years of age, who stated that he had had a similar attack 11 weeks prior to admission. There were, at the date of my visit, I was informed, 10 cases of an apparently similar nature under treatment. On going round the wards with Mr. Forbes we found that the number of cases was somewhat larger than had been anticipated; in a few instances the disease had, apparently, from its comparatively mild character, been overlooked, and the patients themselves had made no special complaint.

On several subsequent occasions also, I visited the Shoreditch Infirmary, and have thus seen nearly all the cases that have occurred up to the time of writing. On two of these occasions Dr. Andrewes secured a number of samples of blood, exudation, &c., for bacteriological examination; but, unfortunately, up to the present the results obtained by him have been practically negative.

There cannot, however, be any doubt that these cases of skin disease at the Shoreditch Infirmary are identical in nature with those which I previously investigated at the Bethnal Green Infirmary. With the object of substantiating this statement, I append, in brief, the clinical histories of five of the Shoreditch cases. These histories Mr. Forbes has been good enough to copy for me from the Infirmary records.

At Shoreditch, as was witnessed in the previous outbreaks at Bethnal Green, Paddington, and Marylebone, the incidence of the disease has been limited almost entirely to the Infirmary. Here there have been, thus far, 51 cases (with five deaths), out of a total at the time that the disease commenced of 449 patients; while only five cases have occurred in the Workhouse, which immediately adjoins the Infirmary.

Moreover, as in former instances, the disease has for the most part singled out persons over middle age who were debilitated by previous chronic illness of one kind or another. The sex incidence of attack has shown no great disparity, 23 males and 28 females having been attacked, of whom four males and one female have died. The total number of patients on the books of the Infirmary on March 31st, 1894, was 449, of whom 227 were males and 222 females (including infants).

On the same date the inmates of the Workhouse numbered 794—371 males and 423 female (including infants).

On making inquiry as to the possible exciting cause or causes of the epidemic at Shoreditch Infirmary, I found a belief prevalent that it had in some way or other been brought about through the water supply, which is peculiar to the institution.

Previously to June 1893 both Workhouse and Infirmary were supplied with water from the mains of the New River Water Company, though they obtained, in addition, a comparatively small quantity from a well on the premises. In February 1893 this well was deepened by boring to the extent of 100 feet, sufficient water being thus obtained for the

entire supply of both institutions. A few months later, the use of the New River Company's water was discontinued.

The Clerk to the Guardians of St. Leonard's, Shoreditch, informs me that as far as he is aware no analysis of this well water had been obtained *previous* to this deepening of the well; and he adds that the work was undertaken merely with a view to increasing the amount of water to be obtained from this source. In October 1893, after the deepening of the well was completed, but before use of the water was commenced, the Guardians obtained from Mr. H. R. Gregory, F.I.C., an analytical report on the water, of which I append a copy, and concerning which that gentleman remarked:—"From the foregoing results it "will be seen that this is an extremely pure and soft water, entirely free "from organic impurity derived from animal source, and is therefore "well fitted for general domestic use and consumption."

In his detailed analysis Mr. Gregory mentioned that among the "total solids" he found a trace of oxide of iron. Since that date, however, the amount of iron present appears to have increased considerably; the water at the present time invariably leaves a yellow stain in any vessel in which it is allowed to stand for any length of time, and, indeed, the water first drawn from the pipes is often markedly discoloured.

It was doubtless this fact which gave rise to the impression that this water supply might be implicated in the causation of the skin disease which has made its appearance during the last few months. On inquiry, however, I was quite unable to obtain any trustworthy evidence in support of such belief, and although no analysis of more recent date than that to which I have referred has been obtained, there appears no reason for supposing that, except as regards the presence of a distinct amount of iron, the water is otherwise than of good quality. In this connexion also it is worthy of note that the well water is supplied alike to the Workhouse and to the Infirmary, and that until quite recently no cases of the disease appeared in the Workhouse. Thus far, indeed, there have occurred but five cases in the Workhouse, and the cause of these attacks, as also of the others which appeared in the adjoining Infirmary, must, I think, be sought elsewhere than in the quality of the water supply.

In like manner as in my Bethnal Green inquiry, I carefully went through the diet sheets with the assistance of the medical officer, in order to learn which of such articles of food or drink were in use in both Workhouse and Infirmary and which were provided in one or other portion alone of the institution.

As the result of my inquiries I found that what I have already written in the first section of this report concerning Bethnal Green is practically true for Shoreditch also. Thus *cheese* can be at once excluded, since, although it is in daily use in the Workhouse, none is supplied in the Infirmary. *Potatoes*, however, are given in the infirmary with all meat and fish diets.

It is somewhat curious that the *fish* made use of in the Workhouse is obtained once a week from Grimsby, while the comparatively small quantity required for the Infirmary is obtained daily from a local contractor. The *meat* supplied to the Infirmary consists exclusively of legs of mutton.

The *bread* supplied to both portions of the institution must be of identical quality, seeing that the whole quantity is both made and baked in the Workhouse, whence a portion is in due course supplied to the Infirmary.

Butter and *eggs* are also of similar quality in each instance, as also is *meat*, with the exception that beef and certain joints of mutton do not

find a place in the Infirmary dietary; milk is also supposed to be of like quality in both cases, the total amount supplied at any one time being divided between the two portions of the institution, of which the Infirmary obtains by far the larger share. Indeed, milk is practically excluded from the Workhouse dietaries, except such small quantity as is supplied in tea and puddings.

Tabulation of the inmates of the Infirmary attacked by epidemic skin disease according to the various food-stuffs comprised in their dietary at the time of invasion, shows that of the 50 patients (one patient who came in with the disease is not included in this number) attacked in the Infirmary during the course of the epidemic—

25, or	50	per cent.,	were on a diet	containing	meat daily.
2, or	4	"	"	"	eggs daily.
13, or	26	"	"	"	beef tea daily.
23, or	46	"	"	"	mutton broth daily.
4, or	8	"	"	"	fish daily.
50, or	100	"	"	"	milk daily.

As was found to be the case in the earlier epidemics at the Bethnal Green and City of London Infirmaries, so here it will be seen that of the various articles of diet supplied to patients in the Infirmary, milk was the only one which had been taken in common by all those attacked by the disease. At the same time it is not supposed to be supplied to inmates of the Workhouse. Five cases of the disease, however, occurred in the House, but, as will be seen later in this report, there is reason for believing that all these persons had obtained and consumed varying quantities of milk.

On account of these facts, and of my previous experience at other infirmaries, I made special inquiry as to the *source* and *quality* of the milk supply. In view of the results of my investigations at the Bethnal Green and City of London Infirmaries, it appeared not a little interesting to learn that the same milk contractors, Messrs. A., of Homerton, had also been supplying the Shoreditch Workhouse and Infirmary for some two years past. The amount of such supply, I learnt, had averaged 37 barn gallons per diem for the fortnight previous to my first visit. The Clerk informed me that the contract price to the Shoreditch Guardians is at present 1*s.* 8½*d.* per barn gallon (7½*d.* per barn gallon above the contract price of milk supplied by these contractors to Bethnal Green). The terms of the contract are, I found, as follows:—"Genuine new unskimmed milk, pure and unadulterated, "to register not less than 8 per centum of cream after standing for 24 "hours in an ordinary lactometer to be provided by the Guardians."*

The per-centage of cream is estimated by the storekeeper, usually twice daily, and an account is kept, which I had the opportunity of examining. The storekeeper informed me that the quality of the milk supplied by Messrs. A. had not been good for a considerable period and had become suddenly worse about the middle of February last.

Having from my previous investigations into outbreaks of the epidemic skin disease in question, found reason to believe that the incubation period of the disease up to the date of appearance of the eruption is usually about a fortnight, I paid special attention to the storekeeper's record of quality of the milk, as regards specific gravity and amount of cream, during the week but one previous to the outbreak of the first case in the Infirmary. Such record for March 12th, 1894 (a fortnight

* Sidney Martin gives the cream of full-cream milk as 10–15 vols. per cent., and of half-creamed milk as 5–6 vols.—Text Book of Hygiene, vol. 1, p. 435.

previous to appearance of eruption in the first case), and for the two previous and two following days, I give below. From this it will be seen that on March 12th the amount of cream was less than half that required by the terms of the contract.

Table showing Specific Gravity and Per-centage of Cream in Milk supplied to the Shoreditch Workhouse and Infirmary.

		Sp. gr.	Per-centage of Cream.
March 10th, 1894	M.	1,033	5 per centum.
	A.	—	4 „ „
„ 11th „	M.	1,033	5 „ „
	A.	—	—
„ 12th „	M.	1,031	3 per centum.
	A.	—	—
„ 13th „	M.	1,031	5 per centum.
	A.	—	6 „ „
„ 14th „	M.	1,033	8 „ „
	A.	—	5 „ „

From previous acquaintance with the method in which Messrs. A.'s business was conducted it was obvious that it would be impossible to trace the actual source of the milk which had been supplied to the institution on any particular day or days; the names of different farmers borne on the labels of the various milk cans affording no guarantee that the contractors were even dealing at all with such a man. For these reasons it was quite hopeless to undertake search for any possible source of contamination of the milk, human or other, assuming that there was ground for suspicion that the milk bore some causal relationship to the disease in question.

That some such causal relationship did actually exist it is impossible to deny; and such a hypothesis is, I think, not inconsistent with the observed facts of the case.

Reference to the Infirmary diet table shows indeed that milk, as such, is to be given only in connexion with diets Nos. 4 (low) and 7 (children). But it enters, in small amount, into all other dietaries, along with the tea consumed at breakfast and supper. As a matter of fact, however, practically all patients in the Infirmary, as I was informed by the Medical Superintendent, receive an extra half pint, at least, of milk daily. In the Workhouse, on the other hand, no milk is supposed to be given, except such as is contained in tea.

It will be seen from the appended lists of cases of the skin disease that all with the exception of five occurred in the Infirmary, and it was not until the malady had attained fairly considerable dimensions that the first case in the Workhouse was observed.

On being informed of the occurrence of this case (Charlotte C——, æt. 62), I asked whether she had been in receipt of an allowance of milk and was told by the Medical Officer that such was *not* the case, the patient being on infirm diet only. This being so it appeared not unlikely that some new light might be thrown on the etiology of the disease by investigation into the special circumstances of the case. As a result of such further inquiry, however, it appeared that this woman had been employed since January 28th, 1893, in the Matron's Stores, and in consideration of such extra work had been allowed a quart of

milk daily. Two other women named H—— and E—— had, I found, been employed in the Matron's Stores for a longer period than C——, but neither of these had received such extra allowance of milk. Neither of these women, up to the present, has contracted the disease. As far as could be learnt C—— had never visited the Infirmary, but being over 60 years of age, she could go out of the house for a short period once every fortnight.

The other Workhouse cases (Nellie C——, æt. 22; Priscilla C——, æt. 49, Sophia G——, æt. 64; and Henry S——, æt. 65) either occurred or were first noticed later on in the course of the epidemic. As far as is at present known these four patients had not been having, previous to their illness, any milk beyond that given in the tea. In view, however, of the definite statement to this effect made to me in the first instance with regard to the woman C——, it is somewhat doubtful whether such statement in reference to these cases can be implicitly relied on. I have since learnt that one of these women had been receiving an allowance of from one to two pints of milk daily, and that it is probable that all the other cases had obtained varying quantities of milk although they had no definite allowance.

All the patients attacked in the Infirmary had previously been taking a greater or less quantity of milk daily, and with the exception of [illegible] I was quite unable to find any article of diet which was common to all the persons in the Infirmary who suffered from the malady in question.

Neither could I discover, in the surroundings of the inmates of the Workhouse and Infirmary, any circumstance which was peculiar to those attacked with the disease, or even to those parts of the Institution in which cases had occurred.

S. MONCKTON COPEMAN.

August 1894.

ADDENDUM A.

Shoreditch Infirmary.

Clinical History of Cases of Epidemic Skin Disease.

Case I.

John H——, aged 73, admitted on the 16th January 1894, suffering from bronchitis, was on diet 3, meat and potatoes with half a pint of milk for seven weeks before eruption, always had half a pint of milk daily since his admission. Bronchitis treated by simple expectorant mixture.

April 9th.—Numerous small red pimples on chest; general condition, normal; skin, itchy.

April 10th.—Spots extended down arms.

April 11th.—Spots all over body, arms, and legs.

Pimples now gradually coalesced so as to form a uniform redness over, watering; eyelids, œdematous; conjunctivæ injected; some discharge from ears. Temperature was up to 100° (about) every evening, and normal in the morning. On the 12th it rose to 103 at 4 p.m., but later that gradually fell to normal, and since the 16th of April has only once or twice of times above normal, and even then never above 100°. His general health was quite as good as ever, the irritation made him restless, but his appetite was as usual. The urine occasionally contained albumen. Testicles were swollen.

April 26th.—Desquamation set in all over body. On the hands and feet of this patient the desquamation was remarkably coarse, the epidermis of several of the fingers came off whole, leaving behind a tender red skin.

At present patient is subject to occasional relapses.

Case II.

George S——, aged 60, admitted on the 28th December 1893, suffering from hæmoptysis. At time of eruption diet was No. 4 (milk diet) with half a pint of beef tea and half a pint of milk; was on that for 2½ months before eruption, having been always on milk since his admission.

Eruption began on the 17th April 1894, as red patches on the backs of the fingers close to the nails. These patches were not itchy, they gradually spread up the arms and over the body and legs. In between the patches a number of small minute papules appeared, and according to the patient these spots were extremely itchy. The face now became swollen and "lumpy," eyelids œdematous; œdema was also present over the body. Temperature was mostly above normal, but never higher than 101·3°.

Albumen was always present in urine.

Patient's condition, which was by no means good before the attack, suffering as he was from phthisis, now became worse. On the 3rd May, patient noticed "lumps" in his axilla. Glands were found acutely inflamed, gradually went on until abscess formed, which was opened and pus drained off. Patient's ankles, knees, and elbows became much swollen. General condition getting worse. Testicles swollen. Abscesses formed near the joints and over various parts of the body. Much of the eruption in a pustular condition.

May 19th.—Patient gradually sinking.

From this date until the 25th, when patient died, the eruption seemed gradually to become cleaner and less pustular.

P.M.—Done on the 28th May 1894. Body generally was very dropsical; there was no appearance of the skin affection from which patient was suffering when he died except a little about the eyes and soles of the feet.

Heart.—Marked pericardial adhesions; valves, atheromatous; left ventricle hypertrophied.

Lungs.—Both apices contained cavities with some surrounding consolidation, fluid and adhesions present in both pleural cavities, more fluid on the left side and more adhesions on the right. Liver, spleen, intestines, and kidneys congested. Number of small whitish elevations noticed on the anterior border of liver.

Case III.

Sarah V——, aged 65, sent into Infirmary on the of 5th May 1884 suffering from sclerosis of nerve centres; also had heart disease.

Rash appeared on 20th June 1894. Patient then on milk diet and taking medicinally Mist. Hydrarg. cum Pot. Iod.

General condition of patient was poor at time of eruption. At onset no nausea or vomiting, patient said she "felt much the same as usual," took her nourishment well, complained of itchiness and feeling of heat in the feet; temperature subnormal in morning, 99·4° at night. The rash for first three days was limited to dorsum and sole of foot; it first appeared as minute scattered bright red papules; these gradually became more numerous, skin much swollen, not tender; papules became clustered together in patches.

On the 26th rash was spreading, and had got above ankle, still kept its brilliant colour. On 27th it was as far up as knees, and the right leg was somewhat worse than the left. During these days patient's general condition continued the same as usual, always said she felt well, and had no nausea.

Once up to the knees the rash seems suddenly to have extended all over the body, on which it presented much the same characteristics as it had on the legs; occasionally over the body and limbs now one noticed some "crusts" as if there had been some "weeping" (as in eczema), but a minute examination did not reveal any vesicular tendency.

On 30th, face very flushed appearance. Not taking food so well for first time. Lies curled up in bed, and does not wish to be disturbed.

Temperature 100° at night (highest during whole period of rash). Œdema of legs is very marked.

On 4th July eruption all over body becoming much duller in colour and now scaly, desquamation is present. Desquamation not fine but in large pieces. Thick horny skin over palms of hands and soles of feet coming off.

14th July.—Desquamating very freely. General condition good.

20th July.—Body and limbs clear of desquamation. Still remains on hands and feet.

During this time occasionally there was a trace of albumen in urine. No sugar. Bowels tendency to constipation, and laxitives were freely given.

25th July.—Patient not so well. Temperature and pulse normal. Rash has reappeared on feet. Has the same characteristics as previously. Œdema well marked. No albuminuria.

1st August.—Rash did not spread beyond knees. General condition worse than at any previous time of illness. Rash subsiding. Ordered some stimulant for first time.

16th.—Œdema and rash gone, except for some staining left by the latter. Improving in herself well. Takes fluid nourishment well.

Case IV.

Robert P——, aged 56, admitted on the 10th May 1894, suffering from an indurated leg. Was at once put on diet 3 meat and potatoes, and half a pint of beef-tea; no milk. Medicinally he took some iron, and lead-and-opium lotion was the application to leg.

June 16th.—Small pimply rash on face first, arms and legs [illegible], lichenous in appearance; occasionally it is in patches, which are composed of numerous pimples or papules clustered together. No nausea or vomiting; tongue, clean; feels as well as usual. Temperature, normal. Pulse, 68.

June 18th.—Face, swollen; eyelids, œdematous bags; rash thicker, bright colour, vesicular here and there; tendency to "weep." Temperature, normal; urine, no albumen; taking nourishment well.

June 21st.—Face very puffy; rash spreading intensely all over body where it presents the same characteristics as it did on appearing on face and legs. Yellow crusts on face, and a couple of small crusts on legs. Temperature is gradually rising to-day: normal in the morning, gone up to 100° at night. Patient "off his food", not so well.

June 22nd.—Temperature gone up to 101·4 this morning. Patient has had several rigors; urine [illegible] no albumen. Pulse 84. Good deal of exudation on face, but the rest of body is free; exudation seems to stiffen linen, eyelids very "baggy," and has conjunctivitis of both eyes. Patient put on large doses of quinine and iron with digitalis.

On the 23rd much better. Œdema of face less; rash over body seems to have sunk into a simple general deep red injection of the skin resembling the rash of scarlatina, but with a more mottled appearance. Still has one or two yellow crusts. Temperature, 99°; has some balanitis.

25th July.—Body and limbs desquamating freely in flakes; has no itchiness now. Urine, no albumen. Temperature, normal.

After [illegible] date desquamation continued four weeks; temperature would come readily to [illegible] about would not feel so well, and on examining the rise would generally be found a slight recurrence of the affection, which, however, as in the case of almost all the relapses, yielded at once to treatment. At present (20/8/94) patient is still desquamating slightly, still has relapses, and although he has had a rather severe attack his general condition is good.

Case V.

John C——, aged 49, admitted on May 23rd suffering from gout. Diet 4 with half a pint of milk. Had that from admittance until eruption appeared.

Patient was on guiacum mixture for sometime before rash came out on the 11th of July 1894.

The scrotum was the first part affected, caused intense irritation, and on examination the skin seemed inflamed and moist; pimples or papules could not be seen. General condition remained the same as formerly; no vomiting or nausea; no diarrhœa; tongue, normal; urine, normal.

13th July.—The thin cuticle over the scrotum has peeled off, leaving a moist red surface, very tender; no testicular swelling. Temperature, normal. Patient feels well. Over the body there is present a lichenous pimply eruption, very thick and itching.

17th July.—Eruption on body remains the same; scrotum the only place that there has been any attempt at "weeping." General condition, same.

19th.—Desquamation in this case "fine" over all the body.

21st.—Relapse of rash on body, which was followed speedily by desquamation.

ADDENDUM B.

Shoreditch Infirmary.

Table showing part of the Body on which the Eruption first appeared.

Part first affected.	No. of Male Cases.	No. of Female Cases.	Total Cases.	Per-centage.
Arm and Forearm	14	13	27	50·9 per cent.
Face and scalp	3	4	7	13·2 „ „
Feet and legs	3	3	6	11·3 „ „
Hands	1	3	4	7·5 „ „
Back	—	—	—	—
Neck	—	3	3	5·6 „ „
Chest and abdomen	1	2	3	5·6 „ „
Ears	—	—	—	—
Thigh and groins	1	1	2	3·7 „ „
Scrotum	1	—	1	1·8 „ „
Total	24	29	53	

ADDENDUM C.

Letter from the Clerk to the Guardians of the Poor of the Parish of St. Leonard, Shoreditch, London.

Clerk's Office,
213, Kingsland Road, N.E.,
7th May 1894.

My Dear Sir,

You probably know that frequent complaints have been made of the quality of our milk supply with respect to the per-centage of cream, and samples have been taken and analysed by the Sanitary Authority. To furnish you with a complete history of the proceedings would be a lengthy affair and is probably unnecessary. There was no evidence to justify a prosecution under the Adulteration Acts, and the Guardians were not inclined to commence an action for breach of contract. They propose to reserve to themselves further power under the next contract they enter into. The analysts' report did not give the constituent parts, but stated merely that there was as to three samples, three per cent. of water beyond the "normal," and as to another sample, that it was "of low quality."

With regard to the water, I am not aware that any analysis was undertaken *before* deepening the well. The work was undertaken with a view to increasing the supply, and not from any misgiving as to the purity of

of Epidemic Skin Disease; by Dr. Copeman.

the water. After the deepening was completed, and before we recommenced to use the water in October last, the Guardians received the analyst's report, of which I send herewith a copy.

I am, &c.
ROBERT CLAY,
Clerk.

Dr. Copeman,
Local Government Board,
Whitehall, S.W.

COPY of ANALYSIS by H. R. GREGORY, F.I.C., of a SAMPLE of WATER from the WELL at the WORKHOUSE of ST. LEONARD'S, SHOREDITCH.

7, Queen's Court,
Chancery Lane, London, S.W.
27th June 1893.

Sample of well water contained in two Winchester quarts marked—
"Sample of water taken from well in Shoreditch Workhouse, after 25 "hours' continuous pumping, on June 22nd, 1893, at 10.45 a.m., in "presence of Engineer, R. Larcombe, Master," received on the 23rd inst. was analysed, with the following results:—

Total solids per gallon - - - - (did not blacken when heated.)	43·05 grains.
Saline ammonia per million - - - -	0·20 ,,
Albuminoid or Organic ammonia ,, - - -	0·01 ,,
Nitrogen or nitrates per gallon - - -	None.
Chlorine or chlorides ,, - - - - -	5·53 ,,
Oxygen absorbed from permanganate in 4 hours -	0·0189 ,,
Colour in two-foot tube nearly colourless, very pale blue.	

The sample contained a slight trace of suspended matter, which, when collected, was found to consist of sand and carbonate of lime.

Degrees of hardness - - - -	4·2 grains.
,, after boiling - - - -	3·2 ,,
The total solids were composed as follows:—	
Silica - - - - - -	0·71 grains.
Oxide of iron - - - - -	trace
Carbonate of lime - - - -	3·22 ,,
Carbonate of magnesia - - - -	2·96 ,,
Chloride of sodium - - - -	9·11 ,,
Sulphate of soda - - - - -	19·19 ,,
Carbonate of soda - - - -	6·60 ,,
Combined water, trace of organic matter -	1·26 ,,
	43·05 grains.

From the foregoing results it will be seen that this is an extremely pure and soft water, entirely free from organic impurity derived from animal source, and is, therefore, well-fitted for general domestic use and consumption.

(Signed) H. R. GREGORY, F.I.C.

REPORT by PROF. CROOKSHANK, M.B., on SAMPLES of WATER and MILK submitted to him by the GUARDIANS OF ST. LEONARD'S, SHOREDITCH.

Bacteriological Laboratory, King's College,
London, 6th August 1894.

SIR,

I beg to report the results of the bacteriological analyses of the samples of water and milk, in accordance with your instructions from the Guardians of the Poor of the Parish of St. Leonard's, Shoreditch.

I need not describe all the technical details of the processes to which the samples were subjected, but I will briefly give the results.

Sample A. was a sample of hot water taken from the kitchen, June 25th, at 9 a.m. It was received at King's College at 2.30, and examined the same afternoon. This remark applies to the other samples as well.

It was found to contain about 60 micro-organisms per cubic centimetre, and was, therefore, bacteriologically very good.

Sample B., a sample of cold water, taken at 9 a.m. from the tap within the sink on the same day, was exceptionally pure. There were practically speaking, no micro-organisms present, a result so unusual in the case of tap-water, that the examination was again repeated with the utmost care, but the same results followed. This excessive purity of tap-water is so unusual, that I am tempted to suggest that the samples may have been by some chance wrongly labelled. This, however, is only a matter of scientific interest, both samples must be pronounced as bacteriologically pure. And no micro-organism was isolated which could, in my opinion, in any way account for the outbreak of skin disease in the Infirmary.

I will now pass on to refer to the samples of milk.

Sample C. was from milk supplied by the contractor at 7 a.m., June 25th, and labelled No. 1, Westerdale, Melton Mowbray Churn, No. 786A. This sample contained about 500,000 to the C.C., about half of which were liquefying micro-organisms, and many producing greenish discoloration, and odour of putrefaction. No such result could be obtained from a perfectly fresh sample of pure milk. It indicates contamination from the air or some other source, possibly water. But neither in this sample, nor in the other samples of milk received at the same time, was I able to succeed in isolating any new micro-organism, or to ascertain any cause for the outbreak at the Infirmary,

Sample D., supplied by the contractor from milk No. 2, Eady Whissendine, No. 265A, contained numerous micro-organisms, but there were not many liquefying organisms present, or the same septic odour in the cultivations. It was unquestionably the best of the three samples.

Sample E. supplied by Eady Whissendine, No. 1,557, contained over 700,000 micro-organisms to the C.C., and the same remarks which were applied to C. must be emphasized in the case of Sample E.

These results confirm those obtained in my previous investigations of milk and water under suspicion of producing an outbreak of skin disease, but, though I am unable to regard the disease as arising either from the water or the milk, I am of opinion that better milk should be supplied to the Infirmary.

(Signed) Edgar M. Crookshank, M.B.,
Professor of Comparative Pathology and
Bacteriology, and Director of the Laboratory,
King's College, London.

ADDENDUM D

Cases of Epidemic Skin Disease: Shoreditch Infirmary.

Males.

No.	Ward.	Transfer.	Name.	Age.	Admission.	Disease.	Previous Illness.	Commencement of Eruption.	Diet and Extras.	How long on previous to the Eruption.	Relapse.	Result.	General Condition at time of Attack.	Remarks.
1	11. W.B.	12. W.B.	William W.	59	30.3.94	Erysipelas [illegible]	Ch. ulcer of leg.	11 weeks before admission.	Ordinary diet			Cured. 13.6.94.	Debilitated.	The man says that he had a similar attack in Essex, which he attributed to drinking bad water.
2	11. W.B.	12. W.B.	Arthur H.	41	24.6.93	"	Ulcer of leg	26.3.94	4. and ½ pint milk.	6 weeks	Yes 18.6.94	Cured	"	The man had erysipelas in his leg and albuminuria.
3	4. E.B.	12. W.B.	Thomas H.	65	10.10.93	"	Gout	31.3.94	3. " "	3 months	Yes 28.4.94	"	"	On his recovering the face and eyes, and delirium, temp. normal.
4	12. W.B.	12. W.B.	John H.	73	16.1.94	"	Bronchitis	9.4.94	3. " "	7 weeks	Yes	"	"	The eyes were swollen, were running, skin peeling in large flakes from hands and feet: temp., 103°.
5	11. W.B.	12. W.B.	George S.	60	28.12.93	"	Mucopto[illegible] disease.	17.4.94	4. ½ pint beef tea, and ½ pint milk.	2½ months	"	Dead from [illegible] and heart disease.	"	Testicles swollen, [illegible] formed near joints and in different part of body: temp. [illegible]
6	3. E.B.	8a. E.	Stephen T.	54	9.9.93	"	Mucous Bronchitis.	21.4.94	5. ½ pint milk	4 "	No	Nearly well	"	Had not spread [illegible]
7	11. W.B.	12. W.B.	John G.	71	20.12.93	"	Gastritis	22.4.93	3. ½ "	2 "	Yes	Still relapsing	"	Had [illegible]

W.B. = West Block. E.B. = East Block. C.B. = Central Block. L.I.W. = Lying in Ward.

No.	Ward.	Transfer.	Name.	Age	Admission.	Disease.	Previous Illness.	Commencement of Eruption.	Diet and Extras.	How long on previous to the Eruption.	Relapse.	Result.	General Condition at time of Attack.	Remarks.
8	8A. E.	12. W.B.	William H.	86	11.8.92	Exfoliating dermatitis.	Cardiac valve disease.	29.4.94	3. ½ pint beef tea, ½ milk.	2¼ months	Yes	Died from syncope.	Debilitated.	No albumen.
9	7A. E.	12. W.B.	Samuel K.	85	18.11.93	„	Prolonged decubitus.	1.5.94	4. and ½ pint milk.	6 „	„	- - -	- -	Peeled one week after eruption.
10	4. E.	12. W.B.	Benjamin J.	74	28.8.93	„	Cardiac disease.	.5.94	4. ½ beef tea, ½ pint milk.	1 month	„	Died from pyoemia.	„	Eruption afterwards became pustular, and large abscess.
11	4. E.	8A. E.	Isaiah James M.	81	19.11.92	„	Senectus	63 9 4	4. ½ pint milk	15 months	No	Nearly well	„	Slight attack.
12	8A. E.	5. E.	Thomas McG.	64	3.1.94	„	Morbus cordis.	10.5.94	4. 1½ pints milk	2 „	Yes	Died. 16.6.94	„	Had serious relapse.
13	8A. E.	- -	Joseph P.	54	24.10.93	„	Ulcer of leg	145. 4	3. ½ pint milk	6 „	„	Nearly well	„	Has small abscesses on fingers, and in axilla.
14	8A. E.	8. E.	Thomas G.	60	21.12.92	„	Ch. bronchitis.	25.5.94	3. ½ „ „	3 „	No	Improving	„	Rash appeared on arms; slept next to G.
15	14. W.B.	12. W.B.	Richard B.	70	27.3.94	„	Ch. Bright's disease.	31.5.94	4. ½ pint milk, ½ beef tea.	26 days	„	Cured	„	Albuminuria; temp., 99·80.
16	11. W.B.	12. W.B.	John D.	59	8.3.94	„	Fracture of fibula.	4.6.94	3. ½ pint milk	1 month	„	„	„	No albumen.
17	11. W.B.	12. W.B.	Joseph D.	50	6.4.94	„	Gout	5.6.94	3. ½ „ „	1 „	„	„	„	Albuminuria.
18	Workhouse.	8A. E.	Henry S.	65	18.6.94	„	Nil	6.6.94	3. 1 „ „	2 years	„	„	„	Began in arms and hands; working in the stores; infirmary.
19	8A. E.	8. E.	Edmund G.	71	31.3.93	„	Cerebral embolism.	8.6.94	5. ½ „ „	5 weeks	„	Improving	„	Rash appeared in face first.
20	13. W.B.	12. W.B.	Robert P.	56	10.5.94	„	Cellulitis of leg.	16.6.94	3. ½ pint beef tea, ½ pint milk.	1 month	Yes; temp. 11.12.13 July, 100. 22.6.94, 100.40.	Still relapsing.	„	He has rigors occasionally, face and eyes very much swollen, and eczematous discharge over body; temp., 101°.

W.B.=West Block. E.B.=East Block. C.B.=Central Block. L.I.W.=Lying-in-Ward.

No.	Ward.	Transfer.	Name.	Age	Admission	Disease.	Previous Illness.	Commencement of Eruption.	Diet and Extras.	How long on previous to the Eruption	Relapse.	Result.	Clinical Condition at time of Attack	Remarks.
21	13 W.B.	13. W.B.	James P.	60	28.9.94	Exfoliating dermatitis.	Ulcer of leg	18.6.94	3. ½ pint milk	2 months	No, no temp	Cured	Detected	He was in the same ward as P., but at the end of the ward. No communication between these.
22	8. E.	-	George B.	78	29.3.93	,,	Fracture of femur.	8.7.94	3. 1 ,, ,,	2½ ,,	No	Weak	,,	Appeared on hands and arms first.
23	11. W.B.	12 W.B.	John C.	49	23.5.94	,,	Gout	11.7.94	4. ½ ,, ,,	1½ ,,	Yes	Cured	,,	Began on scrotum and then over the body. No A's.
24	3. E.	-	Walter C.	36	2.1.94	,,	Rheumatic arthritis.	12.8.94	3 ½ beef tea, and ½ milk.	1½ ,,		Progressing	,,	Began in knee; subsequent appearance at first intensely itchy.

Females.

1	Separation Ward	W B.	Elizabeth H.	77	6.2.94	Eczema tous dermatitis.	Ch. bronchitis and eczema	15.4.94	4. ½ pint milk, ½ pint beef tea.	15 days	Yes 15.4.94	Died	Delirious	She had eczema 8 years ago, and was treated there, and on and off since, and passed out as cured.
2	1. W.B.		Ann H	53	6.8.94	Exfoliating dermatitis.	Epilepsy	21.4.94	3. ½ pint milk	44 months	No	Cured	,,	Passing away.
3	10 W B		Ann H	80	30.1.93	,,	Cardiac disease and bronchitis	21.4.94	4 ½ ,,	3	Yes	,,	,,	No admission.
4	2. W.B		Matilda A.	72	12.4.94	,,	Ch. bronchitis	28.4.94	3. ½ ,,	14 days	No	,,	,,	,,

W B = West Block. E B = East Block. C B = Central block. L I W = Lying in Ward.

No.	Ward.	Transfer.	Name.	Age	Admission.	Disease.	Previous Illness.	Commencement of Eruption.	Diet and Extras.	How long on previous to the Eruption.	Relapse.	Result.	General Condition at time of Attack.	Remarks.
5	Workhouse.	4 E.B.	Nellie C.	22	7.5.94	Exfoliating dermatitis.	Parturition, 26.12.93.	- -	Infirm diet, 1 quart milk.	4 months	No	Had been confined.	Debilitated.	Cannot obtain any history to be relied on.
6	1A. W.B.	-	Hannah R.	35	14.10.92	„	Neuritis	1.5.94	3. ½ pint milk	12 „	„	Cured	„	Peeling slight.
7	6. E.	-	Elizabeth B.	80	8.1.93	„	Morbus cordis.	5.5.94	4. ½ pint milk, 1 egg.	4 „	„	Improving	„	Was in a very weak state.
8	7. W.B.	-	Jane J.	74	12.5.93	„	Ch. bronchitis	6.5.94	5. ½ pint milk	12 „	„	Cured	„	No albumen.
9	1A. W.B.	-	Eliza W.	60	30.1.94	„	Whitlow	12.5.94	5. ½ „	1½ „	„	„	„	Peeling slight.
10	1A. W.B.	-	Elizabeth B.	80	17.1.93	„	Senility and fracture of femur.	16.5.94	5. ½ „	1½ „	„	„	„	Peeling slight, albuminuria.
11	3. E.	-	Charlotte F.	59	18.10.93	„	Ulcer of legs	19.5.94	3. ½ „	4 „	„	- - -	„	Had a gastric attack about the end of month.
12	L.I.W.	1A. W.	Martha P.	15	5.4.94	„	Parturition	26.5.94	3. 2 pints milk	7 weeks	Yes	Cured	„	Peeling all over, had eczema of ears, albuminuria.
13	1A. W.B.	-	Henrietta T.	68	6.12.93	„	Ch. bronchitis	28.5.94	4. ½ pint milk, ½ beef tea.	2 months	No	„	„	Peeling slight.
14	3. W.B.	-	Ellen J.	46	13.4.94	„	Sprained knee	1.6.94	3. ½ pint milk	2 „	„	„	„	No albumen.
15	7. W.B.	-	Mary Ann M.	53	12.7.93	„	Cardiac disease.	1.6.94	4. ½ pint milk, ½ beef tea.	5 „	„	„	„	„
16	7. W.B.	-	Elizabeth B.	60	28.5.94	„	Ulcer of leg	3.6.94	4. ½ pint milk	6 days	„	„	„	„
17	Workhouse.	6. E.B.	Charlotte C.	62	5.6.94	„	Ch. bronchitis	4.6.94	In the workhouse, on infirm diet, and 1 pint milk.	16 months	„	Improving	„	Temp., 103·4°, 8.6.94.; 103°, 9.6.94.
18	6. W.B.	-	Laura D.	17	20.4.93	„	Myxœdema	10.6.94	3. ½ pint milk	9 „	„	Cured	„	No albumen.
19	4. E.B.	-	Eliza R.	80	29.3.94	„	Dissemd. sclerosis.	12.6.94	4. ½ pint milk, ½ beef tea.	10 weeks	„	„	„	——

W.B. = West Block. E.B. = East Block. C.B. = Central Block. L.I.W. = Lying-in-Ward.

No.	Ward	Previous Ill.	Name	Age	Address	Disease	Previous Illness	Date of Admission	Diet and Fevers.	How long in previous to this Hospital	Relapse.	Result	Condition on Discharge	Remarks
21	S. E. R.		[illegible] W.	28	S. L. G.	Erysipelas	Pregnancy	[illegible]	[illegible]	3 weeks	No	Improving	Debilitated.	Began in face, neck and chest.
22	S. W. R.		Sarah V.	19	[illegible]	[illegible]	Confinement [illegible]	[illegible]	[illegible]	6	Yes	Still has rash	"	Rash herpetic, then eczematous.
23	S. E. R.		Mary R.	20	[illegible]		Hemicrania	24.6.94	[illegible]	5	No	Improving	"	Appeared on hands [illegible]
24	Women Convict	S. E. R.	[illegible]	40	S. [illegible]		Phthisis	26.6.94	Weak beef tea and [illegible]	4 years			"	Had no milk but in her tea, she was in the infirmary laundry.
25	2. W. R.		Emma P.	27	S. [illegible]	—	Vomiting	30.6.94	[illegible]	2 days		Cured		No albumen
26	Women Prison	S. E. R.	Sophia G.	64	[illegible]	—	Nil	30.7.94	Weak beef tea and [illegible]	7 [illegible]		Improved	"	Had no milk except in tea, unless she took any when sent [illegible] the infirmary diet-room, which she disliked.
27	2. W. R.		Frances S.	19	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	Yes	Still [illegible]	—	
28	S. E. R.		Ellen M.	20	[illegible]	—	S. [illegible]	[illegible]	[illegible]	[illegible]	No	Improving	"	
29	S. W.		Ellen A.	20	[illegible]	—	Convulsions	[illegible]	[illegible]	[illegible]	"	"	Poor	Albuminuria, rash followed by profuse desquamation.
30	S. R.		Ann V.	28	[illegible]	—	Erysipelas	30.7.94	[illegible]	[illegible]	"	"	Debilitated.	This patient was in C. [illegible] ward separate from the other patients suffering from this disease.

W. R. = Women Convicts. E. R. = Lunatic Block. S. R. = Female Block. S. W. = [illegible] W. R.

D. M. P.

ADDENDUM E.

Shoreditch Infirmary.

Diet Table.

Diets.	Dinner.									Breakfast and Supper.					Daily.
	Meat.	Potatoes.	Bread.	Mutton Broth.	Rice Pudding.	Milk.	Fish.	Butter.	Porter.	Bread.	Butter.	Tea.	Milk.	Sugar.	Gruel.
	Oz.	Oz.	Oz.			Pt.	Oz.	Oz.	Pt.	Oz.	Oz.	Pt.	Pt.	Ozs.	Pts.
No. 2. Full. Males	6	12	—	—	—	—	—	—	—	7	1½	1	—	—	—
No. 2. Full. Females	5	12	—	—	—	—	—	—	—	5	1½	1	—	—	—
No. 3. Medium. Males	4	12	—	—	—	—	—	—	—	6	1½	1	—	—	—
No. 3. Medium. Females	4	12	—	—	—	—	—	—	—	5	1½	1	—	—	—
No. 3g. Females	—	—	—	—	—	—	—	—	—	5	1½	1	—	—	2
No. 4. Low. Males	—	—	2	1	1	—	—	—	—	4	1½	1	—	—	—
No. 4. Low. Females	—	—	2	1	1	—	—	—	—	4	1½	1	—	—	—
No. 5. Fish. Males	—	12	—	—	—	—	8	—	—	5	1½	1	—	—	—
No. 5. Fish. Females	—	12	—	—	—	—	8	—	—	4	1½	1	—	—	—
No. 6. Chop. Males	Chp. 6	12	—	—	—	—	—	—	—	6	1½	1	—	—	—
No. 6. Chop. Females	6	12	—	—	—	—	—	—	—	5	1½	1	—	—	—
No. 7. Children. Sun. Tues. Thurs.	3	6	—	—	—	—	—	—	—	4	½	—	½	—	¼
No. 7. Children. Mon. Wed. Friday	—	—	—	1	1	½	—	—	—						
No. 7. Children. Saturday	—	6	—	—	—	—	6	½	—						
Infants under 2 years	—	—	7	—	—	2	—	½	—	—	—	—	—	—	Weekly 4

Note.—All articles *not included in the above* Dietary are to be treated as extras.

Ingredients to be Used.

Beef Tea.—To contain 1 lb. of meat to 1 pint (leg of mutton pieces or chuck).

Mutton Broth.—For 1 pint: 4 ozs. mutton, mutton liquor, and mutton bones, 1 oz. Scotch barley, ½ oz. of herbs and onions, salt and pepper as required.

Tea.—2 ozs. of tea, 5 ozs. of sugar, and 1 pint of milk to 8 pints.

Rice or Arrowroot Pudding.—1 oz. of rice or arrowroot, ½ pint of milk, ¼ oz. of sugar.

Oatmeal Gruel.—2 oz. of oatmeal to 1 pint of water.

D. M. Forbes, Medical Officer.

ADDENDUM F.

Parish of St. Leonard, Shoreditch.

Dietary Tables for the Workhouse.

New Dietary Table for the Able-bodied of an Age or		Breakfast.		Dinner							Supper.	
		Bread.	Oatmeal Gruel.	Cooked Meat.	Fish. §	Potatoes or other Vegetables.	Bread.	Rice or Suet Pudding.	Broth or Pea Soup.	Fresh Stew.	Bread.	Oatmeal Gruel or Broth *
		Ozs.	Pints.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Pints.	Ozs.	Ozs.	Pints.
Sunday	Men	6	1½	5	—	12	—	—	—	—	6	1½
	Women	5	1	4½	—	12	—	—	—	—	5	1
Monday	Men	6	1½	—	—	—	4	—	1½	—	6	1½
	Women	5	1	—	—	—	4	—	1½	—	5	1
Tuesday	Men	6	1½	5	—	12	—	—	—	—	6	1½
	Women	5	1	4½	—	12	—	—	—	—	5	1
Wednesday	Men	6	1½	—	12	8	2	—	—	—	6	1½
	Women	5	1	—	12	8	2	—	—	—	5	1
Thursday	Men	6	1½	—	—	—	—	16	—	—	6	1½
	Women	5	1	—	—	—	—	14	—	—	5	1
Friday	Men	6	1½	—	—	—	2	—	—	24	6	1½
	Women	5	1	—	—	—	2	—	—	20	5	1
Saturday	Men	6	1½	—	—	—	—	16	—	—	6	1½
	Women	5	1	—	—	—	—	16	—	—	5	1

* Broth.—M. 1½ pts. W. 1 pt.—To be given for supper twice each week, in lieu of gruel, the particular days to be at the discretion of Master.

§ Fish.—Well boiled batter.

Dietary Tables for the Workhouse—*continued.*

No. 2 Dietary Tables for the Infirm of all Ages.		Breakfast.			Dinner.							Supper.		
		Bread.	*Butter.	Tea.	Cooked Meat.	Fish.‡	Potatoes or other Vegetables.	Bread.	Rice or Suet Pudding.	Broth or Pea Soup.	Irish Stew.	Bread.	*Butter.	Tea.
		Ozs.	Oz.	P.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Pts.	Ozs.	Ozs.	Oz.	Pt.
Sunday.	Men	5	1/2	1	4	—	12	—	—	—	—	5	1/2	1
	Women	4	1/2	1	4	—	12	—	—	—	—	4	1/2	1
Monday.	Men	5	1/2	1	—	—	—	4	—	1 1/2	—	5	1/2	1
	Women	4	1/2	1	—	—	—	4	—	1 1/2	—	4	1/2	1
Tuesday.	Men	5	1/2	1	4	—	12	—	—	—	—	5	1/2	1
	Women	4	1/2	1	4	—	12	—	—	—	—	4	1/2	1
Wednesday.	Men	5	1/2	1	—	12	8	2	—	—	—	5	1/2	1
	Women	4	1/2	1	—	12	8	2	—	—	—	4	1/2	1
Thursday.	Men	5	1/2	1	—	—	—	—	16	—	—	5	1/2	1
	Women	4	1/2	1	—	—	—	—	16	—	—	4	1/2	1
Friday	Men	5	1/2	1	—	—	—	2	—	—	24	5	1/2	1
	Women	4	1/2	1	—	—	—	2	—	—	20	4	1/2	1
Saturday.	Men	5	1/2	1	4	—	12	—	—	—	—	5	1/2	1
	Women	4	1/2	1	4	—	12	—	—	—	—	4	1/2	1

* An allowance of dripping may be given, in lieu of butter, when ordered by the Guardians.

‡ Fish.—With melted butter.

ADDENDUM G.

INGREDIENTS

Soup.			Broth.			Gruel.		
Name and Description of Ingredient.	Quantity of each Ingredient to a Gallon.		Name and Description of Ingredient.	Quantity of each Ingredient to a Gallon.		Name and Description of Ingredient.	Quantity of each Ingredient to a Gallon.	
	Ozs.	Pts.		Ozs.	Pts.		Ozs.	Pts.
Australian meat - - -	16	—	Raw meat - - -	8	—	Oatmeal - - - -	16	—
Peas - - - -	—	1½	Oatmeal - -	8	—			
Vegetables - - - -	24	—	Vegetables - - -	4	—			
			Added to liquor in which meat for meat diet is boiled.					
Meat necessary to soup and broth.								

Ingredients—*continued.*

Puddings.			Irish Stew.			Tea.		
Name and Description of Ingredient.	Quantity of each Ingredient to a Gallon.		Name and Description of Ingredient.	Quantity of each Ingredient to a Gallon.		Name and Description of Ingredient.	Quantity of each Ingredient to a Gallon.	
	Ozs.	Lbs.		Ozs.	Pints.		Oz.	Pts.
Suet Pudding—			Australian meat - - -	2	—	Tea - - - -	1	—
Flour - - - -	9	—				Milk - - - -	—	1
Suet - - - -	3	—	Vegetables—					
			Potatoes - - -	4	—			
Rice Pudding—			Carrots and onions - -	2	—			
Rice - - - -	4	—	Rice - - - -	2	—			
Milk - - - -	1 pint	—	Flour - - - -	2	—			

Sanctioned provisionally by the Local Government Board, and by order of the Board of Guardians.

October, 1886.

Robert Clay,
Clerk to the Guardians.

Local Government Board letters, 6th May, 1880.
10th October, 1884.

Resolution of Guardians *re* Fish, 3rd October, 1883.

App. A. No. 11.
On an Outbreak of Epidemic Skin Disease; by Dr. Copeman.

App. A. No. 11. On an Outbreak of Epidemic Skin Disease, by Dr. Downes.

III.—REPORT ON FURTHER OUTBREAKS OF AN EPIDEMIC SKIN DISEASE IN CERTAIN METROPOLITAN WORKHOUSE INFIRMARIES.

During the summer of this year, and subsequent to the occurrence of cases of the unusual form of skin disease at the Bethnal Green and Shoreditch Infirmaries, which has formed the subject of the foregoing reports, a number of other and similar outbreaks of greater or less magnitude have appeared in certain other infirmaries and workhouses. Concerning these I purpose giving in the present report such information as I have been able to gather.

Information having been received from the Medical Superintendents of two or three of these other institutions of the appearance of the disease in queston among the patients under their charge, it appeared desirable to learn, as nearly as possible, to what extent the malady had recently prevailed in the Metropolis. With this object, Dr. Downes addressed, in September 1894, a circular letter to the medical officers of each of the Metropolitan Infirmaries, asking whether any cases of the disease had been observed during the present year; what, if any, was their number; and whether there were any cases under treatment at the time of writing.

The replies received to this circular showed that although one or more, and in two instances a considerable number of, cases of the so-called "epidemic dermatitis" were at the time under treatment, the disease had been by no means so widely spread or as prevalent as might have been anticipated from various statements in reference to the matter which had found their way into the medical and lay press.

Replies in the negative as to occurrence of the disease during the present year were received from the following institutions:—

METROPOLITAN INFIRMARIES and WORKHOUSES.—EPIDEMIC SKIN DISEASE.

St. George's Union Infirmary.
" " Workhouse.
Holborn " "
" " Infirmary.
St. Saviour's " "
" " (Three) Workhouses.
Wandsworth and Clapham Union Infirmary.
Mile End Infirmary.
St. Pancras Workhouse.
" (St. Anne's Home).
" Infirmary.
Lewisham "
" Infirmary (not yet open).
Bethnal Green Workhouse.
" " Infirmary.
Strand Union "
" " Workhouse.
St. Mary, Islington.
St. Giles-in-the-Fields and St. George, Bloomsbury, Workhouse.
" " " " Infirmary.
Camberwell Union (Gordon Road) Workhouse.
St. John, Hampstead, Infirmary.

Whitechapel Infirmary.
Greenwich Union Workhouse.
„ „ Infirmary.
Paddington Infirmary.
Islington Infirmary.
„ Workhouse.
Poplar „
St. Olave's „ (Tanner Street).
„ „ Infirmary.
Chelsea Infirmary.
New Wansdworth Infirmary.
Parish Street Workhouse (Horsleydown).
Lambeth Infirmary.
„ Workhouse.
Westminster Workhouse.
Woolwich Union Workhouse.
„ „ Infirmary.
Hackney Union Infirmary.
„ „ Workhouse.
Stepney Union, Ratcliff, Workhouse.

On the other hand, the replies giving details as to presence of cases of the disease, either at the time when Dr. Downes's circular was issued (September 1894) or earlier in the year, were received from—

Stepney Union Infirmary;
St. George's-in-the-East Infirmary;
St. Mary Abbott's Infirmary, Kensington;
Marylebone Infirmary, Notting Hill;
Fulham Infirmary (2 cases only);
City of London Infirmary;
Camberwell Infirmary (1 case only).

In addition to these must be mentioned Shoreditch Infirmary, on which I have already reported, and to which a circular had not been sent; and also the Marylebone Workhouse, the cases from which place had, I found, been passed on for the most part to the Infirmary at Notting Hill. Two cases also had been transferred from the City of London Union Workhouse at Homerton to the City of London Infirmary in Bow Road as suffering from "dry eczema," which were afterwards recognised as being of the epidemic variety.

On receipt of the replies to Dr. Downes's circular letter, I at once visited nearly all the infirmaries in which cases of the epidemic skin disease were under treatment, or in which cases had occurred earlier in the year, including the City of London Infirmary, whereat, since my report on it to the Board, several additional cases had occurred. I also visited the Marylebone Union Workhouse, as I learnt that Mr. Rayner, the Medical Superintendent, had there some cases under his charge which had not been transferred to the infirmary at Notting Hill.

As the result of my visits I found in certain instances that the number of patients actually suffering from the disease was somewhat in excess of that which had been supplied to Dr. Downes, either for the reason that cases had occurred subsequently to the date on which information had been sent to him, or that their nature had not previously been recognised.

Subject to such additions, the number of patients attacked by epidemic skin disease during the present year, and also the number of deaths

referred to that malady which have occurred among such patients up to the end of September 1894 are as follows:—

Name of Institution.	Cases.	Deaths.
St. George-in-the-East Infirmary	126	17
St. Marylebone „	67	7
Shoreditch „	66	6
Stepney „	36	—
City of London „	29	—
St. Mary Abbotts, Kensington, Infirmary	15	3
Fulham Infirmary	2	2
Camberwell Infirmary	1	—
Total	342	35

From these figures it appears that while the fatality rate has varied somewhat in the different institutions, the cases which have terminated fatally form 10·234 per cent. of the whole number attacked.

It is possible, however, that the numbers (both cases and deaths) given above are somewhat too high, as, at the St. George-in-the-East Infirmary more particularly, certain cases are included in the statistics afforded by Dr. Bowlan, the Medical Superintendent, in which no skin affection developed during the whole cause of the illness. Dr. Bowlan justifies such inclusion for the reason that the cases appeared concurrently with others in which a quiet typical rash presented itself, the symptoms being in all respects apparently identical, with the single, though not unimportant, exception of the usual skin lesion. The question being thus raised, it will be necessary to discuss it more fully further on in this report. It may be mentioned here, however, that if the cases in which no definite rash appeared—70 in number—be subtracted from the total cases notified from this institution, the figures, subject to such correction, will be 56 instead of 126, and the total number of attacks during the year in all the institutions concerned will be reduced from 342 to 272; while of the 17 death in this particular institution for which only six occurred in patients who had presented a typical rash, 11 would have to be subtracted, leaving for all the institutions a corrected total of 24.

Additional Facts respecting the History of the Disease.

In all probability the disease under consideration in this and former reports is by no means a new one even in this country. At the time that Dr. Savill brought forward an account of the outbreak at the Paddington Infirmary, Mr. Hutchinson called attention to an epidemic which occurred in the Greenock Parochial Asylum in 1888. In America, Dr. Henry Blanc,* dermatologist to the Charity Hospital, New Oleans, published in 1892 an account of certain cases of what he terms *Lymphoma Exfoliativum Recurrens*. His paper is specially of interest, however, because he gives an extensive bibliography of the disease, his references going back to a paper by Benjamin Gooch† in the "Philosophical Transactions" for 1769. Among more recent writers on the subject are Leloir and Vidal,‡ who gave the name of *Relapsing Exfoliative*

* International Clinics, Vol. III., 1892.

† Account of a singular separation of the cuticle.

‡ Traité descriptif des Maladies de la Peau, 1891. 3e livraison, p. 163.

Dermatitis to this disease, a fact of which apparently Dr. Savill was not aware when he himself proposed the very similiar one of *General Exfoliative Epidemic Dermatitis*. The latter term, be it noted, makes no reference, as do those employed by Leloir and Vidal, and by Blanc, to the proneness to relapse which Dr. Savill himself admits is a marked feature of the disease.

In a recent paper‡ Dr. Savill expresses the opinion that the term "epidemic skin disease," which I have invariably employed in my reports in dealing with this particular malady, is preferable, as indicating the conditions under which the malady first attracted attention in this country. He further states that the name "general exfoliative epidemic dermatitis," besides being cumbersome, "is not altogether appropriate." With reference to this point there is an undoubted advantage in the use of a term which does not entail the expression of any definite views as to the etiology, characteristics, or pathology of a disease concerning which unfortunately at present comparatively little is known. For these and for other reasons the term "epidemic skin disease" appears indeed to have generally commended itself.

The circumstances of certain of the outbreaks of epidemic skin disease at present under consideration were somewhat different from those of former outbreaks on which I have reported. Thus, in 1893, at Bethnal Green Infirmary, and in the more recent outbreaks at the Shoreditch and St. George-in-the-East Infirmaries, the disease suddenly attacked almost simultaneously a considerable number of inmates, all of whom had been practically confined for some time previously to the particular institution where they were under treatment for other diseases, mostly of a chronic nature.

On the other hand, during the present year more particularly, in certain other infirmaries, the cases have not arisen in so definite a manner, having been scattered over considerable periods of time; while many of the cases, especially the earlier ones, have been received from outside, as, for instance, from workhouses, Salvation Army shelters, and private dwellings, for the most part of the poorest class. Where this has been so, the type of the disease has, especially in some instances, been of a decidedly mild character. More particularly was this the case during the most recent outbreak at the City of London Infirmary, where, with 29 cases attacked, not a single death resulted. At the same time there has seldom been evidence of infection or contagion being conveyed from those suffering attack to the medical officers, nurses, or other attendants. At the St. George-in-the-East Infirmary, however, where the type of the disease was severe, and where cases cropped up in fairly rapid succession, as many as 10 nurses in all were attacked, beside other officials. But whether these attendants owed their illness to personal infection it is not possible to say, as their attack may not unlikely have been due to some cause common to patients and attendants alike.

From what has been stated, it will be apparent that the outbreaks of this epidemic skin disease which have occurred during the present year have presented certain different features as regards their course and duration. Undoubtedly confusion of ideas with reference to the etiology of the disease has been fostered by the non-appreciation of these differences in the various outbreaks. This is a question which will

* "Lancet," Sept. 29, 1894, p. 732.

require further discussion later on in this report, in the section dealing with the possible *exciting causes* of the disease.

It may, perhaps, be again stated here that personal visits have been paid by me to all the institutions where more than one or two cases had occurred, and that I took the opportunity of myself examining as many of the patients supposed to be suffering from the disease as possible, in order to satisfy myself in each instance that the diagnosis of epidemic skin disease was justified.

Certain cases there have been, as already mentioned, at St. George-in-the-East Infirmary, concerning the true nature of which considerable doubt may well exist, seeing that they at no time during the whole course of their illness presented any recognisable skin affection. Dr. Bowlan, the Medical Superintendent, however, is of opinion that they are in reality to be regarded as cases of the disease in question, for the reason that all the symptoms from which they suffered, including malaise, sickness, and feverishness, were of similar character to what was observed coincidently in point of time in other patients who were undoubtedly the subjects of epidemic skin disease. The interesting question of course arises as to whether these patients were not suffering from some concurrent malady of entirely different nature, such, for instance, as influenza.

In reference to this question, Dr. Bowlan has supplied me with a memorandum, which I append to this report, in which he sets out the reasons which in his opinion justify the inclusion of these anomalous cases in the same category with those in which a definite skin lesion was commonly one at any rate of the most marked features of the illness. It was, indeed, the particular feature to which attention in the past has been mainly directed, as is obvious from the term ("dermatitis") originally proposed by Vidal, Leloir, and Savill, as descriptive of the malady in question.

Of the various outbreaks, the consideration of which forms the subject matter of the present report, that which came under observation at the City of London Infirmary has been much the least severe, no constitutional symptoms whatever, according to the statement made to me by the Assistant Medical Officer, having been noticed in any of the patients attacked by the disease. The general mildness of type also of the disease at this institution during the present year is seen from the fact that not a single one of the patients attacked has succumbed to the disease.

These cases, 29 in number, were spread over a considerable period of time, the first having come under notice on April 6th, 1894, and the last on August 1st. All the persons attacked were over 50 years of age, and although in nearly half the total number a relapse occurred at a longer or shorter interval, not one of those patients still in the Infirmary who had suffered attack in the previous year again contracted the disease.

Towards the end of my investigation I learnt that cases of epidemic skin disease had recently come under notice at the Stepney Infirmary; but on visiting the institution I found that the present Medical Officer had only been appointed recently, and that no records were available. As far as could be learnt, it appears, however, that the cases, comparatively few in number, had appeared one at a time, extending over a period of nearly seven months, that none of them had been of severe type, and that in all probability some had been admitted from outside while actually suffering from the disease.

ETIOLOGY.

What has been said under this heading in my previous reports, for the most part applies equally in the case of the outbreaks which have been the subject of investigation during the present year.

A.—PREDISPOSING CAUSES.

1. *Age.*—With reference to this point it has been almost the universal rule that no persons below middle age have been attacked. Only a few exceptions have come under notice. Thus, for instance, at the St. George-in-the-East Infirmary the very first person in whom the disease asserted its presence was an infant at the breast. This child, which was in the lying-in ward, was found on July 19th to present a definite rash, which on the following day showed itself also in the case of this child's mother. At the Marylebone Infirmary a boy, four years old, who was under treatment for rickets, was attacked on September 1st; while in a recent outbreak at a workhouse outside the metropolitan area, two newly-born children were attacked with the disease, whereas the mothers, according to Dr. Vallance, "did not contract the "disease."

Advancing years, as already stated, seem to cause a greater predisposition to attack, and many of the patients who have suffered from the complaint during the epidemic have been 70, 80, and in some cases as much as 90 years of age. Tables are appended showing, for those Infirmaries where the greater number of cases have occurred, the incidence of attack at each of several age-periods.

2. *Sex.*—The tables referred to above also show for each sex the proportion of persons attacked at each age-period. In this connexion it will be observed that, looking to the total number of those attacked amongst the occupants of these two Infirmaries at the commencement of each of the outbreaks, the incidence of the disease has been somewhat heavier on the male than on the female sex.

3. *Previous Ill-health and Hospitalism.*—It has been abundantly evident that persons suffering from chronic and debilitating diseases, particularly if they are at the same time of advanced age, are far more liable to attack than persons in the enjoyment of good health. This fact has been specially obvious in those instances in which Workhouse and Infirmary form practically one building, the attack-rate on inmates being invariably much higher in the latter than in the former portion of the institution. In an earlier epidemic at Bethnal Green, on which I have already reported, certain persons in attendance on the patients, including the Medical Superintendent, were attacked by the disease, and in the latter outbreaks at present under consideration a few similar incidents have been recorded. Thus, at the Marylebone Infirmary a porter, who about the time of the first appearance of the disease during the present year had been put on bath-room duty for some weeks, contracted the disease: while at St. George-in-the-East Infirmary, as already noted, no less than eight nurses suffered from the complaint in the Infirmary itself, and two other nurses at the Workhouse, in addition to the labour master, and the assistant matron. I was unable to learn whether in each instance those who had thus been attacked had previously been more or less out of health, but the mere fact of the extra strain involved by the sudden occurrence of numerous cases of this disease, with the consequent increase of work thrown on the staff, renders this not improbable.

It would also appear that the cubic amount of air space per patient provided in the wards is of considerable importance in reference to the spread of the disease, as is also the aggregation of patients suffering from the disorder when the type is severe. At the City of London Infirmary the Assistant Medical Officer is further of opinion that the virulence of the disease tends to become greatly increased when the patients suffering from it are brought together in a single ward (one for each sex) for purposes of isolation. At the same time, however, he considers that under the circumstances the disease is, as a rule, more likely to run a shorter course (averaging about three weeks in such as recover) than when it appears in milder form in the first instance.

4. *The particular malady for which patients were being treated* previous to invasion of the system by this disease, appears to exert little or no influence in determining the attack. Of the cases sent to the Infirmary from the Marylebone Workhouse, the majority had previously suffered from gout, but this did not hold good with reference to other institutions. Apparently any diseases that are debilitating are about equally likely to have superadded to them an attack of the pecular skin disease under consideration.

5. *General Sanitary Condition of the Institution.*—In the case of the Bethnal Green outbreak, as I have stated in a previous report, it appeared hardly possible but that the extent of the epidemic and the severity of type witnessed in the case of many of the patients affected, may have depended in some measure on the fact that the sanitary condition, and also the general arrangements for attendance on and treatment of the patients in this Infirmary, leave much to be desired. In another connexion also, attention was directed to the fact that the Regent's Canal which was in a very foul condition, passes within about 50 yards of the Infirmary at one point, where indeed is situate the ward in which the first patient to be attacked was being lodged.

In the majority of the other institutions in which the epidemic skin disease appeared in 1894, in less severe form, the general sanitary conditions, as also the arrangements in connexion with the treatment of the patients, are decidedly superior to those which were found to exist at the Bethnal Green Infirmary. It is perhaps worthy of note, however that the St. George's-in-the-East Infirmary, which has experienced heavy incidence of the disease in severe type during the present year, is on a site which Dr. Bowlan, the Medical Superintendent, regards as saturated with moisture. He points out that the Infirmary is built on low-lying ground, surrounded on three sides by extensive docks, while on the fourth side, and within a comparatively short distance, is the River Thames. Whether or not the general conditions of site of this Infirmary had any causal connexion, direct or indirect, with the outbreak there of skin disease it is impossible to say, but the possibility of such relationship appears worthy of future investigation.

B.—Exciting Causes.

1. *Food.*—In my previous reports on the etiology of epidemic skin disease as observed more particularly at the Bethnal Green and the Shoreditch Infirmaries during the years 1893 and 1894, I have called attention to certain facts which appear not inconsistent with the theory that some particular article or articles of *food* may have had, in some instances at any rate, causal connexion with the outbreak; and further that of the various articles comprised in the dietaries of these Infirmaries, *milk* is that on which suspicion has mainly fallen.

In the more recent prevalence of the present year, this question has again cropped up, and it is therefore desirable to discuss the various circumstances which tend either to support or, on the other hand, to negative, inference of conveyance by such means of the specific poison of the disease in question. I again directed special attention to all the various articles of food contained in the different dietaries in use in the Infirmary and Workhouse respectively. It soon, however, became apparent that of these, practically all could be excluded with the solitary exception of milk.

Various suggestions however have been made as to other channels by which the skin eruption and other symptoms of the disease might have been brought about, among which may be mentioned the condition of the *drinking water* in use and *irritation of the skin* referred to various articles of clothing, such as coarse undervests, or from new nightdresses worn before having been washed and so still containing in their texture a considerable amount of size or other stiffening material. Careful investigation, however, of the circumstances of each individual outbreak has completely failed to afford any evidence whatsoever in support of such inferences. So too with milk, in certain of the more recent outbreaks, especially at the City of London Infirmary, the Kensington (St. Mary Abbott's) Infirmary, the Fulham Infirmary, and probably also the Marylebone Infirmary, it appears improbable that the outbreaks observed in these institutions were set going by this agency. On making investigation of this question at the above Infirmaries, I was informed in each instance that as far as was known the milk had been of good quality, and that no noticeable change for the worse had been observed in the supplies received during at least a month previous to the appearance of the first cases of the disease, and that there had not been any complaint either from members of the staff or from patients with reference to the condition of the milk during a similar period.

At two of these Infirmaries all the milk served out to the patients is "boiled" previous to use, although in one of these two institutions such is not the case with that portion of the general supply which is reserved for the use of the resident staff. In these instances, supposing that the milk is really brought to the boiling point and kept for a time at such a temperature, it is probable that any micro-organisms previously present in it would be destroyed by the process. It should be borne in mind, however, that boiling would not necessarily destroy the dangerous properties of a non-living chemical poison, supposing such to have been introduced in some way or other into the milk. The fact also that where the milk used for the patients was boiled while that of the staff was not, those who suffered from the disease in question were nevertheless found practically among the patients alone, does not carry as much weight as at first sight might appear to be the case, seeing that attacks are in almost every instance confined to the aged and debilitated.

It deserves to be noted, however, that in the case of those institutions in which such information as I was able to gather did not tend to implicate the milk service, the epidemic disease did not attack a large number of patients simultaneously as in the case of the previous outbreak at the Bethnal Green Infirmary, and at St. George-in-the-East Infirmary. In the last-named institution the first case was quickly followed by a number of others, scattered all over the Infirmary, which therefore made it appear highly probable that attack must in all these cases have been brought about by some common cause which, however, was not apparently operative in the adjoining workhouse.

On inquiry at St. George-in-the-East Infirmary, I found that the only articles of diet which were practically common to all patients therein were water, milk, and bread. Of these the *water*, which is obtained from the mains of the East London Water Company, is used not only in the Infirmary but in the Workhouse as well. The same statement holds good with regard to the *bread*, of which sufficient is made and baked in the Workhouse for the use of inmates and staff of both portions of the institution. Milk, however, although contained in the dietary of all patients in the Infirmary, finds no place, with the exception of a very small quantity given in tea, in that of the Workhouse inmates For this reason I turned my attention chiefly to the source, amount, and quality of the milk which had been supplied to this Infirmary for such time prior to the appearance of the first cases as would afford an ample allowance for an antecedent period of incubation of the disease. At my request the contracts for milk supply to the institution for the past two years were produced. On looking over them with the steward I was not a little interested to find that on July 1st, 1894,* about a week previous to the appearance in the Infirmary of the first cases of the epidemic disease, not only had a change in the contract been made for the first time for a year and a half, but also that the contract newly accepted was that of Messrs. A——, a firm of purveyors to whom I have referred as having supplied milk to certain other institutions in which I had had occasion to investigate the circumstances of previously occurring outbreaks of epidemic skin disease.

The Medical Superintendent informed me that from the first day on which the new milk supply come into operation he had noticed that it was of obviously inferior quality to that which had previously been in use. But although the amount of cream was estimated daily, no detailed chemical analysis appears to have been carried out, even though, by a process of exclusion, Dr. Bowlan, soon after the appearance of the first cases of the disease in the Infirmary, arrived, as he informed me, at the conclusion that the milk supply must have some causal relationship to the disease which had attacked in rapid succession so many of his patients.

So impressed indeed did he become with this conviction, that on August 13th, 1894, he caused Nestlé's condensed milk to be substituted in the Infirmary for the milk which was then being supplied by Messrs. A——. About three weeks later, namely, on September 9th, 1894, with the consent of the Guardians, Nestlé's milk was taken exclusively into use for the whole institution. This further change was adopted for the reason that several officials of the Workhouse staff who, unlike the inmates, had been in receipt of a daily allowance of Messrs. A——'s milk of greater or less amount, had become attacked by the prevalent disease.

As further evidence of the part probably played by ingestion of the suspected milk in the causation of the skin disease at this particular institution, may be mentioned the fact that within a week of such milk supply being stopped the number of cases of disease commenced to abate.

A much smaller secondary rise occurred in this institution in the number of attacks during the week ending September 15th, 1894, after which, as is seen by reference to the chart appended to this report, the numbers in each instance again fell below normal.

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* I have since learnt that the new supply actually commenced on June 29th.

Such marked rise and subsequent fall in the number of persons attacked, practically corresponding with the commencing use and withdrawal respectively of a particular milk supply, is of much interest, and can, I think, hardly be explained except on the theory that the disease had in reality some causal relationship with exceptional condition of the milk supply, the exact nature of which remains at present undetermined, but which has hitherto been observed to be for the most part a concomitant of a bad quality of milk.

At Marylebone Infirmary, with the object apparently of testing the value of the "milk" theory, the ordinary contract milk was eliminated from the dietary of *certain of the patients only*, but curiously enough, the patients selected were those who had already become attacked with epidemic skin disease; milk was *not*, as might be inferred from a statement appearing in one of the medical periodicals, eliminated from the Infirmary diets altogether. Indeed the medical officers of the institution (where by the way, as I have already stated, I was unable to gather any evidence implicating the milk supply) do not appear to have fully appreciated the point at issue, and as a matter of fact, the disease *went on spreading* in the infirmary. I was also told that no apparent alteration in the progress of the disease was obvious in those particular patients who had been put on Nestlé's milk in place of the ordinary supply. Supposing that milk had indeed been in this Institution the carrier of infection, it is obvious that such change, limited as it was to a few persons already attacked, could have exerted no influence on the progress of the epidemic. The experience therefore of the Marylebone Infirmary in the matter of milk cannot be held to in any way neutralise the apparently positive evidence to be derived from the history of the epidemic at Bethnal Green, Shoreditch, and St. George-in-the-East Infirmaries.

Although the use of Nestlé's condensed milk has now been discontinued at the St. George-in-the-East Infirmary, the milk contract, which existed at the time of the commencement of the recent epidemic, has been determined by the Guardians. The same statement holds good with reference to the milk contracts in the case of the Bethnal Green and Shoreditch Infirmaries, the firm of contractors being the same in each instance. These facts show that at any rate much good has resulted from the attention which has been directed to the poor quality of much of the milk supplied to the Metropolitan Poor Law Infirmaries, even though the thesis as to a possible causal relationship between such milk supplies and the appearance in certain of these institutions of outbreak of epidemic skin disease, may not be considered to be capable of demonstration.

2. *Personal Infection.*—Reference has already been made to the fact that those epidemics in which the milk supply fell under suspicion as having played a part in the causation of the malady, differed in some notable particulars from others in which such was not the case. In this latter category may be included the more recent outbreaks at the City of London and the Marylebone Infirmaries.

With reference to the City of London Infirmary it is at any rate a curious coincidence that the first person to be attacked during 1894 was, at the time of onset of the disease, sleeping not only in the same ward, but actually in the same bed, that had been occupied by the patient who had been the first to suffer attack in the previous year. The majority of subsequent cases which broke out, not only at this institution, but at the Marylebone Infirmary also, occurred, for the most part, in wards which had been invaded during the previous year, and this notwithstanding that some of the wards had, at any rate, been submitted to

some process of disinfection during the interval of freedom from the disease.

Whether or not such occurrences can be taken as affording evidence of the retention of infectivity in these particular wards it is difficult to say, but the fact is worthy of record, particularly in connexion with circumstances which appear not inconsistent with a belief that the disease under consideration is of a more or less infectious nature.

This question of infectiousness I have already discussed in my report on the outbreak of 1893 in the Bethnal Green Infirmary. In this place, therefore, I need only add that in one marked instance already mentioned, that, namely, of a porter at the Marylebone Infirmary, who contracted the disease subsequent to having temporarily been put on duty in the bath-room, and who consequently came into close contact with a number of cases admitted with the disease upon them, it appears highly probable that his attack was brought about by personal infection from one or other of the subjects of the disease with whom he had come in contact.

The recent outbreak at the Marylebone Infirmary is peculiar also for the reason that a number of the cases included in the tables appended to this report, were, when admitted (in many instances from the workhouse) actually suffering from the disease and may therefore have been the means of spreading the disease throughout the institution. This was so in a marked degree on the female side, where, out of a total of 26 cases, no less than 12 were transferred to the Infirmary from the Workhouse because they had become attacked by the disease in question. Thus of the first eight women who came under treatment for the disease in the Infirmary, six were admitted there from the Workhouse, the admissions dating from June 12th, 1894.

The first case, however, to arise in the Infirmary in 1894 was one on the male side, the patient being a man who had been admitted there more than a couple of months previous to the appearance of the disease. He was, at the time of his attack (June 1st, 1894) in Ward H. 3, in which there had been several cases during the previous year, and on making inquiry into the matter I learnt that this particular ward of the Infirmary had not been thoroughly disinfected in the interval, as had others in which former cases had been treated.

Neither of the next two patients on the male side contracted the disease in the Infirmary. One was admitted from outside on June 8th, while the other was transferred from the Workhouse about a fortnight later. Both were suffering from the disease at the time of their admission to the institution.

In all, 41 cases were treated on the male side of the institution, of whom all except five apparently contracted the disease subsequent to their admission. The outbreak extended over a period of about four months, the cases cropping up at more or less irregular intervals between June 1st and September 22nd, the greater number (23 out of a total of 41) occurring during the month of August.

All the cases treated at the Marylebone Infirmary during this period of time were of a comparatively mild type, and there occurred among them no such general elevation of temperature as was observed among the patients during the epidemic at St. George-in-the-East Infirmary. Of the eight deaths which occurred in this institution among patients suffering from the disease, the Medical Superintendent does not apparently consider that in any instance was the epidemic skin disease the sole or even the chief cause of the fatal result.

3. *Relapses.*—Not only in the outbreaks at present under consideration, but in former years also, a certain number of cases presented themselves concerning which there has appeared reason for believing that they had

on one or more previous occasions suffered from similar attack. Relapses at interval of a few weeks from the primary attack have been put on record in a large number of cases since attention was, a few years ago, first directed in this country to the peculiar and special features of the disease, but it is not unlikely that the true nature of attacks, separated by periods extending backwards over months and years, has hitherto passed unrecognised in many instances.

The admission to an Infirmary of such cases during an interval of freedom from the disease, and its re-appearance during their stay in the institution, might, supposing the disease to be of an infectious nature, well account for its subsequent appearance in one or more instances, without any cause for its outbreak being obvious.

The possibility of relapses of this malady after considerable intervals of time is supported by the experience of observers both on the Continent and in America; and during the recent outbreaks I have been assured by several patients that they had suffered on one or more previous occasions from attacks, exactly similar, as far as they could judge, to that for which, at the time of making such statement, they were under treatment. Although, as far as I am aware, no English observer has up to the present, called attention to this peculiarity of the disease, it will I think be admitted that patients could hardly be mistaken in their account of such marked symptoms as a general skin-rash, accompanied often by intolerable itching, preceded usually by general malaise and followed by profuse desquamation.

Further, if the recent experience at St. George-in-the-East Infirmary may be taken as a criterion, the malady does not by any means exhibit one universal type, and consequently it is all the more likely that outbreaks may on occasion have been brought about by the treatment in an institution, among numbers of persons susceptible by reason of age and debilitated system, of a patient suffering from the disease in unrecognisable form.

It would indeed appear not unlikely that the skin-rash, if one of the most frequent, is not an absolutely essential concomitant of the general constitutional disturbance, and *vice versâ*; and that, like influenza, the disease may exhibit in excess, now one, now another, of various symptoms pertaining to it, even within the compass of a single outbreak. It would also appear to resemble in certain respects such diseases as malaria and syphilis, in that its hold on the system may apparently persist, with only occasional manifestations, for an indefinite period.

December 1894. S. Monckton Copeman.

Preliminary Note on Observations on the Pathology of "Epidemic Eczema" during the Year 1894, by Frederick W. Andrewes, M.B., M.R.C.P.

Dr. Andrewe's Report.

I was considerably hampered in my work on this subject in 1893 by difficulty of obtaining suitable material. This year this has not been the case; by help of the Medical Superintendents of the Shoreditch, St. Marylebone, and Kensington Infirmaries, I have been able to make a number of observations on acute cases of the disease, and in some cases I have been fortunate enough to secure ample material from post-mortem examination of persons in whom attacks had proved fatal. The microscopic examination of much of this material I have not yet had time to complete, and I propose here to summarise only the bacteriological side of my observations.

In my previous report I was compelled to arrive at the conclusion that there was no evidence of the constant presence of any one specific

micro-organism in cases of the disease, and I was inclined to believe that this was owing to lack of suitable material on which to work. This year I have examined 13 acute cases—some of them more than once—by improved methods suggested by wider experience; but I have to record an equally negative result.

The methods employed consisted in microscopic and cultural examination of the blood from acute cases, and of fragments of skin, excised in all instances with the patient's consent, from the seat of disease at a very early period, sometimes within one or two days from the first appearance of the eruption. It is on observations of the latter kind that special stress should in my opinion be laid, inasmuch as the constitutional disturbance seems to bear some relation to the extent and severity of the skin affection; whence one may reasonably assume that, if the disease be due to a specific micro-organism, it is in the affected skin that it is most likely to be found. Fearing that my negative results might be due to the use of too powerful antiseptics in sterilising the skin, I have abandoned the use of perchloride of mercury and carbolic acid, and contented myself with thorough washing with soap and water, followed by cleansing with absolute alcohol, which was allowed to dry up before the fragment of skin was excised.

In seven acute cases skin fragments were excised, after surface sterilisation, from the actual seat of the disease; in another case large pieces of skin were, immediately after death, excised from an acute fatal case. Cultures were made immediately—on various nutrient media in all these cases; details will be given later in my complete report. The results were that in five out of the eight cases the cultures remained absolutely sterile; in one case in which the skin had been imperfectly sterilised several species of staphylococci grew; in two others, a white and a yellow staphylococcus grew respectively, the number of colonies being very small.

In eight cases cultures were made from the blood. In five of these the cultures remained quite sterile; in the other three—one or two species of cocci grew.

In three cases I had the opportunity of being present at post-mortem examinations of fatal cases of the disease, but in two of them 48 hours had elapsed since death, and so many putrefactive organisms were present that no satisfactory results could be obtained, though it is noteworthy that cultures from an enlarged femoral lymphatic gland in one of these cases remained sterile. The third case was an exceedingly favourable one—as death occurred on the eighth day from septicæmia—the rash being fully out at the time. I was able to excise pieces of skin within twenty minutes of death, and the post-mortem examination was made at the earliest opportunity after death. Here, however, the skin cultures remained absolutely sterile, and cultures from the heart blood and spleen yielded some four species of staphylococcus, together with a few contaminations derived probably from the air of the post-mortem room.

The last observation which I have made consisted in inserting beneath the skin of a rabbit's ear a fragment of skin excised from a mild but recent case of epidemic eczema. The wound healed at once, and after the lapse of two to three weeks a slight scaliness of the skin appeared in its neighbourhood, while towards the base of the ear a definite eczematous patch appeared. This, however, vanished after about a week, and attempts to inoculate other rabbits have been so far unsuccessful.

I would add that, so far as my own observations have gone, I am not satisfied as to the infectiousness of the malady. This one experiment on the rabbit affords the solitary instance which has fallen under my

own observation, in which the disease appeared experimentally communicable, and I do not wish to lay much stress on a single experiment in which the result was at least equivocal.

The conclusion which I have reached as the result of the bacteriological examination of cases of the disease, during the present year, thus confirms, from fuller data, that which I reached in my previous report. I can find, in the majority of acute cases, no organisms present either in the blood or in the affected skin; where micro-organisms have been found they have been of no constant species, but have included various sorts of staphylococci—some of which at least are normal inhabitants of the human skin, while others which I have tested have no pathogenic powers as regards rodents. Two possibilities suggest themselves. If the disease be truly infectious it may be due, as in the case of certain specific fevers, to a micro-organism which cannot be stained by any of the methods in general use, or grown artificially on any of the cultural media at our command. Or, in the second place, although epidemic, it may not be infectious, and may depend not on any micro-organism at all, but on some chemical poison present in food, or in some way introduced into the body of inmates of certain workhouses and infirmaries at certain times of the year. Analogy with allied skin affections, such as ordinary eczema, of the microbic origin of which we have no valid evidence, would suggest, perhaps, the latter view, and accordingly it would be satisfactory to obtain more convincing evidence of the communicable nature of the disease before we commit ourselves to a belief in its bacterial origin.

ADDENDUM A.

Letter from Dr. Bowlan, Medical Superintendent, St. George-in-the-East Infirmary, with reference to the Diagnosis of Anomalous Cases of Epidemic Disease.

Infirmary, St. George-in-the-East, London, E.,
November 3rd, 1894.

Dear Sir,

I enclose some brief and very imperfect notes of a few more cases which I think bear upon the question of the presence or not of influenza as a factor in the epidemic of skin disease, &c., here.

(1.) The main objection to the influenza theory has always appeared to me to be the prevalence of vomiting or diarrhœa, or both combined, in so many of our cases. For these symptoms are clearly neither common in, nor typical of, influenza.

Of the 126 cases—

- 126
  - 67, gastric or enteric symptoms or both.
    - 48, or 38·0 per cent., vomited.
    - 8, or 6·35 per cent., had diarrhœa.
    - 11, or 8·7 per cent., had *both* vomiting and diarrhœa.
    - 67, or 53·0 per cent., had either vomiting or diarrhœa or both.
  - 59, no alimentary sign of enteric fever or diarrhœa.
- 126

In fact, the vomiting was so prevalent, that I began to suspect irritant poisoning, and tested the beef tea and broth for copper (being cooked in copper), but found no trace of such metal.

The milk then (which had always been viewed with suspicion from when the contract changed on June 29th) was then regarded as the cause.

(2.) And taking the view that the great improvement which followed the use of condensed milk on and from August 13th was due to this change in the dietary I do not see how the influenza theory can be held, excepting on the ground of coincidence, and this I think the vomiting and urticaria disposes of.

(3.) Again, the cases without rash were not all febrile (*vide* cases 3, 4, 5), and yet in most of these cases vomiting was present, thus excluding the possibility of this symptom being simply the reflex of a medulla disordered by blood at a febrile heat, or, in other words, a part of a "general malaise."

(4.) Again, in some cases the "rash" only appeared late (*vide* cases 2 and 5), and was often only very trivial and slight, thus suggesting that the more serious early vomiting (or anorexia or fever) really represented the full initial force of the microbe and its toxins, which had either thus exhausted themselves or had rendered the tissues immune. For if it were a totally different disease one would expect that the skin disease following after would be aggravated and not mitigated.

(5.) Again, these late rashes were often represented by a dry and desquamating condition of the skin (case 2), and in such a case it is reasonable to suppose that the primary state had abated and that the primary illness was the same disease.

(6.) Again, some of the cases might have shown the rash had they lived longer. For some few only survived a few days.

Vide cases of—

Isaac B., attacked 27th July, died 30th July.
Hannah K., attacked 28th July, died 31st July.
Daniel D., attacked 21st July, died 30th July, &c.

(7.) A hæmorrhagic tendency existed in common in *both class of cases*. Of course hæmaturia, &c., is described in influenza, but I take it that most people have found it to be very rare.

Thus—

O.* Bridget D., 32. Vomit streaked with blood.
O. David B., 61. Slight hæmoptysis, with a temperature of 103° F. Vomiting and diarrhœa.
O. Hamal D., 47. Profuse epistaxis.
O. Margaret A., 80. Hæmaturia.
O. Eliza R., 67. Hæmaturia.
R.†John D., 32. Hæmoptysis and slight hæmatemesis.
R. Joseph W., 54. Epistaxis.
O. Hannah C., 27. Diarrhœa (bloody febrile). Is pregnant, and has piles.
O. Amelia W., 58. Hæmorrhage from rectum.
O. John H., 48. Diarrhœa and melæna.
R. Robert F., 61. Several attacks of vomiting with slight hæmatemesis.

In addition, petechiæ and similar blood extravasations in the skin occurred in some cases.

(8.) It has been stated by Dr. Savill that the temperature was never elevated in his cases unless in the presence of "boils" and such like local processes. But the chart of C., No. 1, shows that a high temperature may accompany the rash without any boils. For Catherine C., even supposing she had influenza, had no pulmonary complications, and her temperature could hardly have been elevated for so long a period, except by the presence of the cutaneous affection, which was clearly a general exfoliative dermatitis. And the possibility of influenza having influenced the type of the skin disease, e.g., that a true influenza rash should accompany and modify the other dermatitis is, I think, more theoretical and open to doubt than the proposition that we have one disease to deal with, although somewhat protean in character.

Again, I enclose chart, Case 6, which is that of Pard S., who was attacked three weeks after her confinement. This woman did not appear to have headache or other influenzal symptoms.

* O = No rash. † R = Rash.

She always looked and appeared comfortable. Unfortunately, she could not speak English.

She at no time suffered from *boils*, yet she had a considerable elevation of temperatures; so that I consider Dr. Savill's *ex cathedra* statement on this point is decidedly hasty and wrong.

Her child, on the other hand, who had a very marked attack of the "dry" type of the disease, had no fever.

(Compare Cases 7 and 8.)

Dr. Savill states, too, in his book that some of his nurses had observed influenza-like symptoms at Paddington, which he apparently discredited and ignored.

I have not been able to fix any definite time from onset to appearance of rash. But in several cases this has been from 12 to 16 days, 13 or 14 days being the most frequent.

On the other hand, these were in many cases apparently simultaneous.

Trusting that these rough notes may, at any rate, be of some slight use to you,

I beg to remain, &c.

Dr. Copeman. (Signed) Marcus M. Bowlan.

ADDENDUM B.

ST. GEORGE-IN-THE-EAST INFIRMARY.

Case 1.

Name: Catherine C——, aged 36.
Admitted: June 19th, 1894.

Has been in Infirmary on several occasions with lead colic, sickness, and anæmia. Always made a good recovery.

On June 19th, 1894, she was again admitted as a case of plumbism. She stated that she had been working on odd days at the white-lead works.

She complained of abdominal pain, but there was no acute colic. Appetite poor. Does not sleep well. She is stout, but anæmic. There is a faint "gum line."

Heart, normal. Lungs, normal.

Urine, sp. gr., 1·019, acid. No albumen.

She was put on saline aperient mixture.

She gradually improved and her temperature was always normal.

On June 26th she was put on No. 1 (full) diet, and a ferruginous tonic and aperient was prescribed. She had progressed very satisfactorily, and was able to be up all day. She assisted in the ward work and was practically quite well until July 24th, when her appetite failed and she requested that she might be put on No. 3 diet. Otherwise she was quite well and went about as usual.

Late on the evening of the 28th July, however, she was attacked with *diarrhœa* and *vomiting* (is on aperient medicine). Her temperature was slightly febrile, 100·2°. "La grippe" was provisionally diagnosed and she was ordered a saline mixture.

The next day (July 29th) patient was decidedly ill. The face was flushed and the tongue covered with yellowish fur. She complained of headache, back-ache, and general malaise. There was no evidence of rheumatism though she complained of pains in her limbs. The throat was normal. She was given a mixture of antypyrin and quinine at 11 p.m.

Patient continued thus in a febrile and prostrate condition with no appetite, a dirty furred tongue, headache, and general soreness, &c., until the 11th August, when her face became swollen and erythematous (but no œdema), and a rötheln-like rash appeared over the body and limbs. On the arms and forearms, however, there were in addition *large wheals collections of papules* which gave rise to a good deal of itching. No vomiting.

On August 12th she was ordered Nestlé's milk (urgent) and ordinary milk was cut out of her dietary altogether.

August 13th. Feels much better. Rash still present. August 16th. Inunction with Ol. Eucalyptus began as the rash still persists. August 17th. Felt sick but did not vomit. August 18th. Very thirsty and prostrate. Bowels constipated. August 19th. The rash has almost disappeared from body. But the papular condition on arms and forearms is still marked though showing signs of exfoliating. Urine, sp. gr., 1·020, acid; no albumen.

August 21st. The face and eyelids and forehead are now desquamating. The forearms slightly so. The body is covered by fine brawny scales. Lips very dry and cracked. Tongue moist. August 24th. Patient very much better since last note; bowels relaxed (mixture). Flakey desquamation on face, ear, and scalp. Hair coming out freely. Eyelids are puffy. Desquamation is now progressing rapidly *all over* the body. Those parts on forearms, &c., where there had been large whealy groups of papules now show a peculiar dark yellow pigmentation of the epidermis, raised above the surrounding skin. Her scalp is almost bald, all hair in the axilla has been shed, and the surface of the nails is rough and yellowish.

September 10th. The skin is now quite clear excepting on the front of the wrists, where there is still some thickened yellow epidermis which has not separated. (*See* Chart No. 5.)

Case 2.

Name: Bridget K——, aged 38.
Admitted: July 18th, 1894.

A pale, anæmic, but well nourished, muscular, woman, who, on admission, complained of abdominal pain.

There was a blue line on the gums. Abdomen not tender, and patient did not appear to be in any acute pain. No abdominal retraction or distention.

She vomited several times a greenish-coloured fluid, and continued to vomit at intervals until the 23rd July. When there was no sickness patient was much better.

By July 31st she was practically well again. Patient got up and about ward and kept well till August 5th, when she complained of pains all over, was flushed and febrile.

For some days she continued indisposed and with complete anorexia, but had no further attacks of vomiting.

However, on August 13th, about 7 a.m., she became suddenly giddy and faint on getting out of bed, and fell in the ward. (No head injury.) By 10 a.m. she was very collapsed and dazed, and had a rapid running pulse, and was very restless. Her pupils were equal, but *very widely* dilated, and did not re-act to light.

Patient vomited several times during the day, and was in a state of semi-coma, *i.e.*, unconscious, yet restless. Passed urine; bowels open. Did not vomit during night, and slept at intervals.

On August 14th she was rather restless during afternoon and evening. She had not spoken since 7 a.m. on the 13th instant. There was great difficulty in swallowing, and she was taking little food. At night she was very restless and vomited frequently a dark greenish fluid. She passed no urine during the night.

August 15th. Restless at times, but not so unconscious. She spoke several times during the day.

Vomited several times. Had morphine injection.

A small patch of herpes appeared at the right angle of the mouth.

Very restless at night; did not sleep, and vomited frequently. Passed no urine. Temperature, 97°. Bowels not open. Very delirious at times. Tongue becoming dry and breath foul.

August 17th. Still very restless and delirious. Slept well during the night. Not sick.

By August 18th, she had become a little better, and much quieter; excepting the herpes there has been no evidence of any rash.

But on September 9th there was noticed to be slight desquamation on the middle of the forehead, about the mouth and chin, and at the seat of

the herpes rash. Her hair did not come out. Whether this scaly condition of forehead was simply "physiological" or not is a moot point. The rest of her body remained quite free from desquamation.

Discharged cured and quite well September 28th, 1894. (*See* Chart No. 6.)

Case 3.

Name: Martha T——, age 58.
Transferred from the Workhouse.

She had been in Workhouse since May 31st, 1881.

Had suffered at times from chronic bronchitis, but had never had any skin disease in her life. Her illness began on Friday, August 24th, 1894, when she noticed a rash on her arm, which itched, but she made no complaint to anyone. The next day she felt cold and chilly, and had headache.

She was admitted to Infirmary, Sunday, August 26th. Her face was then very flushed and ruddy. Febrile, feeble, pulse quick and weak. Tongue dry and breath very foul. Very thirsty. No valvular disease, but heart's action very feeble.

There was an eruption on the arms and forearms, on the chest, and about the shoulders, buttocks, legs, thighs, and feet, consisting of fine papules which did not feel "shotty."

Nestlé's condensed milk was ordered in place of the contract supply.

August 27th, tongue very dry. Pulse very feeble. No. sputa. Breath offensive. Ordered brandy daily. Bowels not open.

On August 28th, the tongue was rather better, and her condition generally had improved. As she was very thirsty, lemon juice and soda water was ordered. August 29th. Much better. Breath not nearly so foul. The rash which has been of the dry type is gradually becoming less marked. September 7th. The papules are now giving place all over the body to a fine desquamation. But there are still some distinct yellowish papules about the dorsum of the foot.

The skin was treated at first with zinc oxide and salicylic acid "cream," and afterwards Ung. Eucalypti P.B. was used.

September 27th. The skin is now quite well and normal again. But patient is very feeble and remains under treatment for chronic bronchitis. On a morphine mixture being discontinued (27th September) she vomited a good deal, and morphia had to be again (October 1st) prescribed, since which there has been no sickness. (*See* Chart No. 7.)

Case 4.

Name: Hannah G——, aged 30.
Admitted: 20th July 1894.

Was "confined" some months ago, following on which she had an attack of mania of a hysteroid character. She is decidedly weak-minded, but not a lunatic. She had been an inmate of Infirmary as a case of "debility," bodily and mental, since July 20th, 1894. Her general health quite satisfactory, though a feeble woman. Had not suffered from sickness. Temperature, normal. Is not epileptic.

On August 20th, at 4 p.m., she was attacked with clonic spasms in the face and neck. Speech failed her. Neither arm nor leg affected. Pupils equal and re-act to light.

She was found to be in a semi-conscious condition, but there was no paralysis; pulse quick and feeble; temperature 99.6°. Speech returned in a few minutes, but she could not converse, as her mind was in a "confused" condition. About 5 p.m. she vomited. She vomited again twice during the night, a quantity of a greenish fluid.

On August 21st, as she was still vomiting frequently, she was ordered a bismuth and morphine mixture.

Four days later right hemiplegia and aphasia developed during the night, and she had an epileptiform fit at noon on the following day.

At this time also she was found to be perspiring freely, and three irregular small vesicles were noticed on the back of the right wrist.

On August 26th there were epileptiform clonic spasms of the right side forearm and hand. There was a conjugate deviation of eyes. The patient was semi-conscious.

August 27th. Speech partially returned, but patient cannot converse.

August 28th. Still occasional convulsions on the right side. Right pupil dilated and larger than left.

August 29th. Improving.

Between September 1st and 4th she had several fits, since when she commenced to improve, and has had no further attack.

On September 6th she could utter words, but could not converse. There were apparently some signs of desquamation on the forehead and face.

On September 15th she suffered from considerable mental excitement, and had to be put in a padded room, but by September 17th she had become quiet and was apparently quite well again in all respects.

(Dr. Savill had a case in which paralysis occurred and the patient died.)

In the present case the condition appeared to be functional and like post-epileptic paralysis. The patient, previous to this illness, had never had an epileptic fit. At one period of her illness there was some rise of temperature. She has had no fit since, and is now well (November 3rd,. (*See* Chart No. 8.)

Case 5.

Name: John W——, aged 45.
Admitted: 25th October 1893.

An anæmic, stout man, admitted for fracture at the ankle joint, but quite well in health.

Towards end of July 1894 he complained of having absolutely no appetite, and he looked depressed and unwell. Temperature, normal. Urine, sp. gr., 1·020, acid. No albumen.

A fortnight later, on August 13th, the skin and face appeared somewhat dryish. He remained in a lethargic state, taking very little nourishment, and his breath had an offensive odour.

On September 11th a papular petechial rash, consisting of about a dozen scattered papules, appeared on the forearms. His tongue became dry and raw looking.

Three days afterwards there were petechiæ on the arms and legs, and the skin over the back and chest was desquamating in dry brawny scales. Patient had also slight chronic bronchitis.

On September 20th he became very sick and vomited frequently. This was followed by great weakness and prostration. Ordered bismuth and morphine mixture.

The urine, when examined, two days later, was of sp. gr., 1·018, acid, and showed a deposit of urates, but no albumen.

He died September 26th, 1894, from—1, epidemic skin disease; 2, congestion of lungs; 3, cardiac failure.

Case 6.

Name: Charles J——, aged 49.
Admitted: 23rd August 1893.

This man who was a patient under treatment for chronic gout, was comparatively well until the middle of July, when he became ill with complete anorexia, was depressed and his hair came out so that in the space of two weeks he became almost bald. There was no fever, neither was there any skin rash.

On July 30th diarrhœa set in; he gradually became weaker, and he died on August 5th.

Case 7.

Name: Henry H——, aged 62.
Admitted: 27th May 1894.

This patient was under treatment for an ulcerated leg, and had otherwise been perfectly well till the night of August 6th, 1894, when he vomited

and had an attack of diarrhœa. His temperature was at this time 98° Fahr.

Next day he was practically well again; was not sick, and had no diarrhœa. He continued well and taking full diet till August 13th, when he again vomited and became very collapsed. He had an obstinate attack of hiccough, and "congestion of the lungs" supervening, he died at 2.30 p.m. on August 14th. There was never any rash.

Case 8.

Name: George C——, aged 52.
Admitted: 31st July 1894.

This patient was in good general health till August 6th, 1894, when he was attacked with vomiting without any apparent cause. He continued to vomit all his meals and could not even retain milk. Temperature, normal.

On August 12th he was put on Nestlé's milk instead of ordinary milk. He vomited, however, in the evening, and twice on August 15th.

After this he was not again sick, and got apparently quite well again.

On September 5th, however, petechial spots were noticed on the legs, but there was no sign of desquamation anywhere. There had never been any positive rash.

Cases 9 *and* 10.

Name: Elizabeth R——, aged 33, and her baby aged six weeks.
Transferred from the Workhouse.

The mother had a rigor on September 13th, 1894, and complained of pains "all over." Had headache (frontal) and back-ache. She did not vomit nor feel sick. Her forehead was distinctly scaly and desquamating, but the rest of her body was free. She had a dirty tongue and looked flushed and ill.

Her temperature on September 14th, at 3 p.m., was 102·2° F.; at 7 p.m., 99·8° F.; and at 10 a.m., on September 15th, was 98·8° F.

The temperature was not taken when she had the rigor on September 13th, as she made no complaint at the time.

By October 11th her forehead was normal again.

Her child.—On September 14th her child, which was at the breast, was found to have a fine, discrete, papular, horny rash on the neck, about the shoulders, on both arms, and to a slight extent on the legs. The body was almost entirely free. The temperature was normal.

Desquamation followed, and the skin was quite free by October 11th. The case was treated with zinc and salicylic cream.

"Is it probable," says Dr. Bowlan, "that the mother and child in this "instance were suffering from two different diseases? I think there can "be no reasonable doubt but that both of them had a mild attack of "epidemic 'skin disease,' but of somewhat different types."

(*Copy.*)

West Ham Workhouse,
Leytonstone, E.
September 28th, 1894.

Sir,

I wish to make the following report to the Local Government Board, as to the epidemic of skin disease at present prevalent in this Workhouse.

There are 42 cases of an unusual form of skin disease under treatment.

28 are females, 14 are males; these patients are in separate wards, no other patients mixing with them.

They are nearly all of an advanced age, 6 men and 14 women being over 70; 3 men and 8 women over 60; 8 were admitted from the body of the Workhouse, 2 from outside, the rest were already in the Infirmary for other diseases.

In five cases deaths have occurred, undoubtedly accelerated by this disease.

1. A man who had gout for years, who became affected on the 22nd June, and died on the 15th August 1894.

2. An old man, 83 years of age, quite well, until attacked on the 10th July. He became demented, and died on the 8th August 1894.

3. A man, 63 years old, had hemiplegia for years; he had cellulitis of the leg on the 28th February, which got well. On the 15th May, dermatitis occurred, after which he became demented, and died 27th July 1894.

4. R——, M. (87), a case of chronic bronchitis, became dangerously ill when attacked on the 20th September. He died on the 23rd.

5. P——, John (78), a case of senile dementia, paralysed, and bedridden. He was attacked with dermatitis and died 18th September 1894.

Altogether, there have been 128 cases; of which 11 have left the house cured. Nine have died (that is, 4 in addition to those above-mentioned), but in these cases I do not consider that dermatitis had anything to do with the deaths, which occurred after they were fairly recovered, the actual causes being (1) senile gangrene; (2) cerebral softening; (3) apoplexy; (4) bronchitis; their ages being respectively 77, 67, 88, and 73. There are, thus, 110 persons now in the institution who have or have had the disease, 42 of whom are still suffering. The greater number are almost well; 6 women and 3 men, however, are very bad, one of the latter having bronchitis.

With regard to milk being the alleged cause, the following figures may be instructive.

There are 739 persons under medical treatment in the Infirmary, more than half, or 372, have milk daily; 82 have been attacked, about 22·04 per cent.

On the other hand, 367 have no milk, or only a small portion with their tea, 28 or 7·63 have been affected.

This great difference may be explained by the fact that, with very few exceptions, the victims of this disease are among the aged and weak, who naturally form the large majority of those on milk.

For instance, out of the 110, 28 were below 60, whilst 41 were actually above 70.

Again, many cases developed in the body of the house and were transferred to the Infirmary. In the house these people would have a meat diet, and on being attacked were put on a milk diet with no bad result.

The milk supplied to the inmates is all boiled. The milk supplied to nearly 100 officers is not boiled, and is exactly the same, but only two of the latter have suffered slightly.

With regard to infection or contagion.

Two newly born infants were attacked with a similar eruption; in one case the child was "on the bottle," but nursed by, and sleeping with, his mother, who did not contract the disease. The other was actually suckling, but his mother also remained free.

A woman with a nine months old child became affected. She was partially suckling her infant, who also had milk, but is perfectly free from disease of any sort.

A woman, aged 45, was successfully operated on for strangulated hernia, and the wound was almost healed when she became affected with dermatitis, which spread from the wound in an erysipelatous manner over the whole body, face, and limbs; she ultimately got quite well and had no rise of temperature.

There have been no fresh cases now for some days, and the others are progressing favourably.

I am, &c.

(Signed) Ernest Vallance,
Assistant Medical Officer.

W. E. Knollys, Esq.,
Assistant Secretary,
Local Government Board.

CHART showing number of Deaths and number of "Epidemic" Attacks week by week from May 6th 1894 to October 20th 1894.

Green dots and line - Deaths per week from all causes.

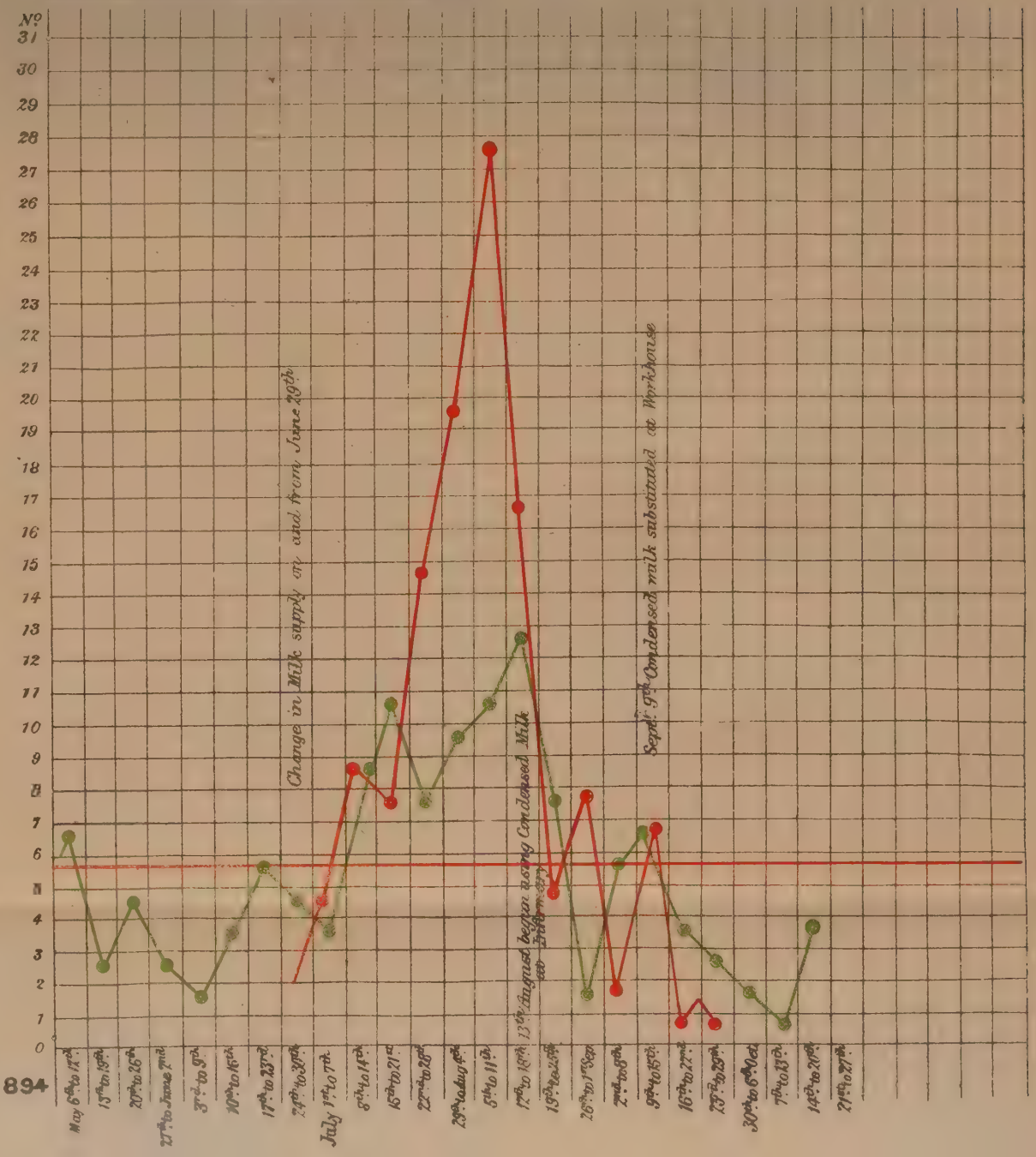
Red ..... ,, ... ,, ... - Attacks per week due to the epidemic whether with or without rash.

This Chart takes in both Infirmary and Workhouse cases, viz all cases.

Average number during July 1894 of Persons in

Infirmary	260
Workhouse	414
Total	674

Average number of Deaths calculated on 4 years = 6 per week.

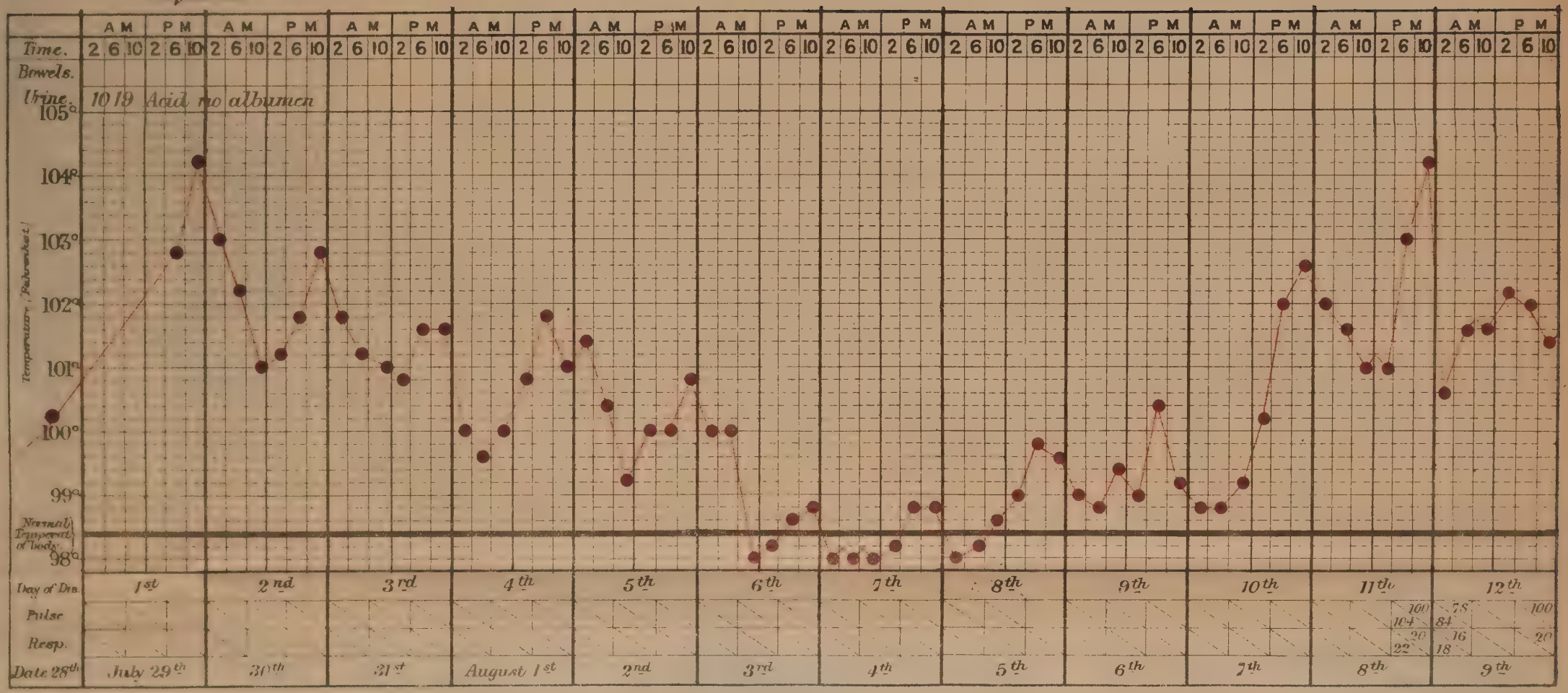


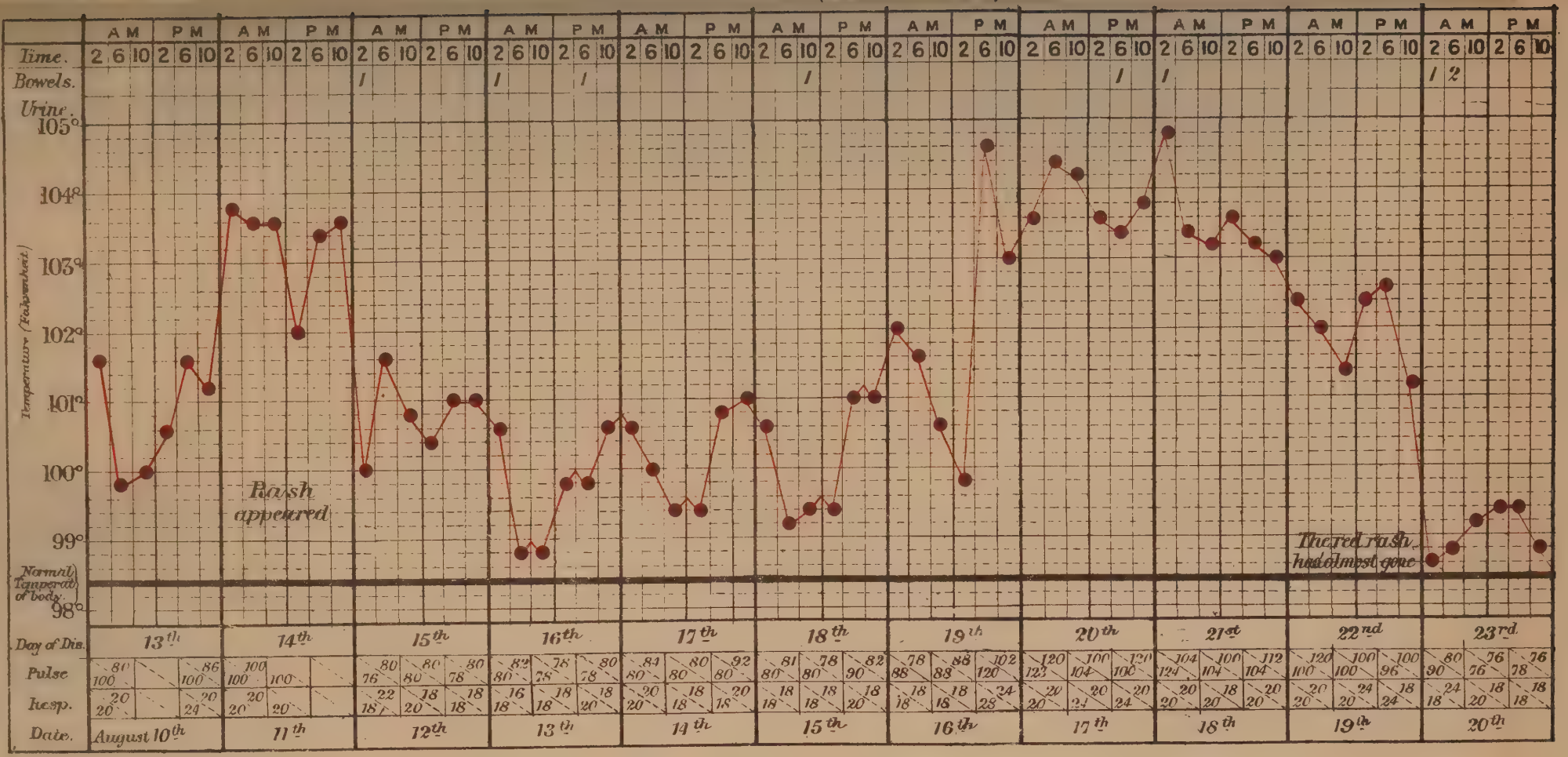
St George-in-the-East, Infirmary.

Chart No. 5.

Name Catherine C.
Age 36.
Diet. No. 3. Was on No. 1 Diet up till 24th July 94 when she said her appetite was not so good & requested No. 3.

Date of admission
June 19th 1894.





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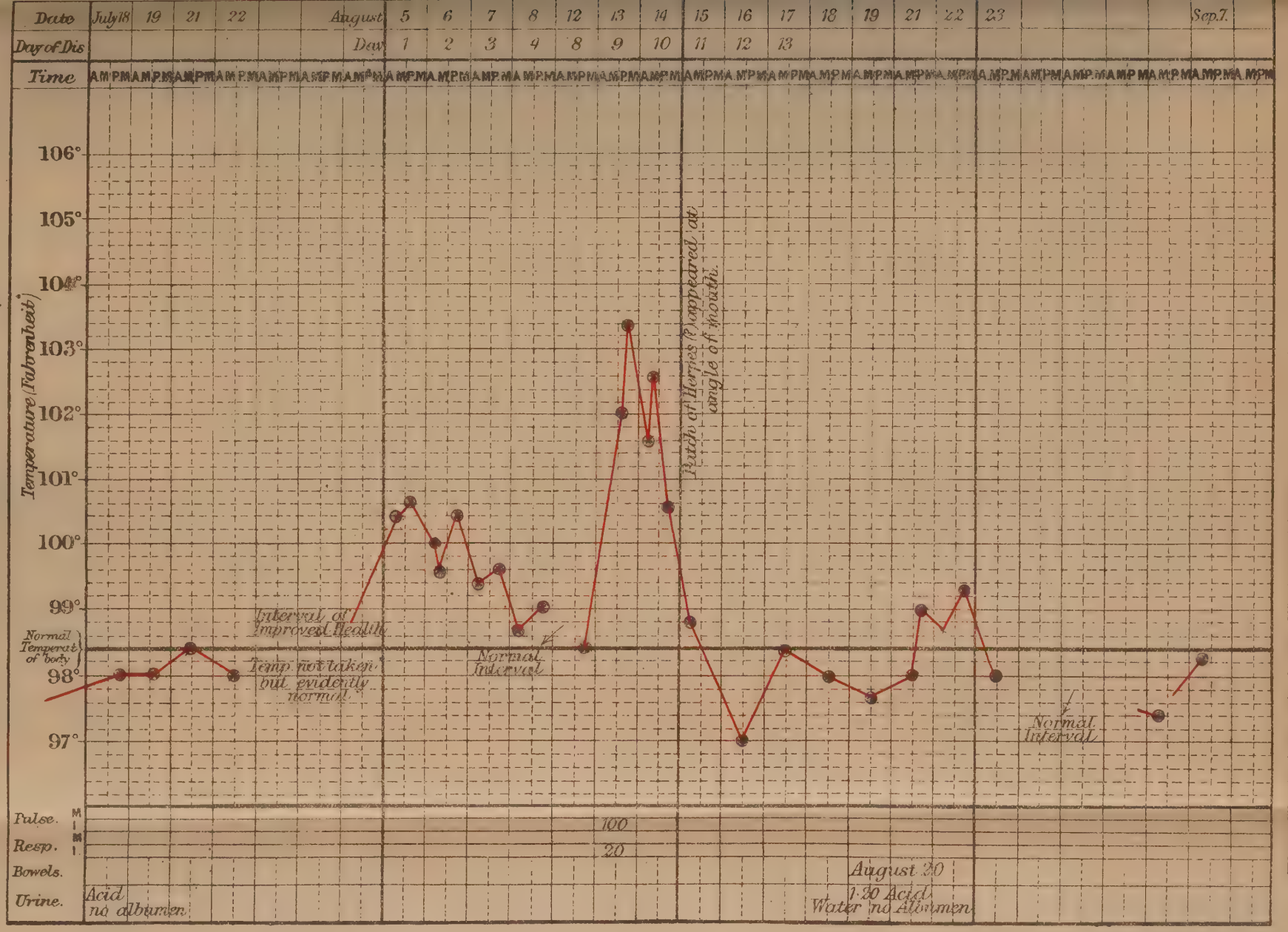
Name Bridget K.

Age 38

Admitted July 18th 1894.


Date
July 18 19 21 22 August 5 6 7 8 12 13 14 15 16 17 18 19 21 22 23 Sep. 7.
Day of Dis
Day 1 2 3 4 8 9 10 11 12 13
Time
Temperature (Fahrenheit)
106° 105° 104° 103° 102° 101° 100° 99° 98° 97°
Temperature (Centigrade)
42° 41° 40° 39° 38° 37° 36° 35°
Normal Temperat of body
Interval of Improved Health
Temp not taken but evidently normal
Normal Interval
Patch of Herpes (?) appeared at angle of mouth
Normal Interval
Pulse. M
Resp. M
Bowels.
Urine.
100
20
Acid no albumen
August 20
1·20 Acid
Water no Albumen

Wyman & Sons, Ltd. Lith. 6637.12.94

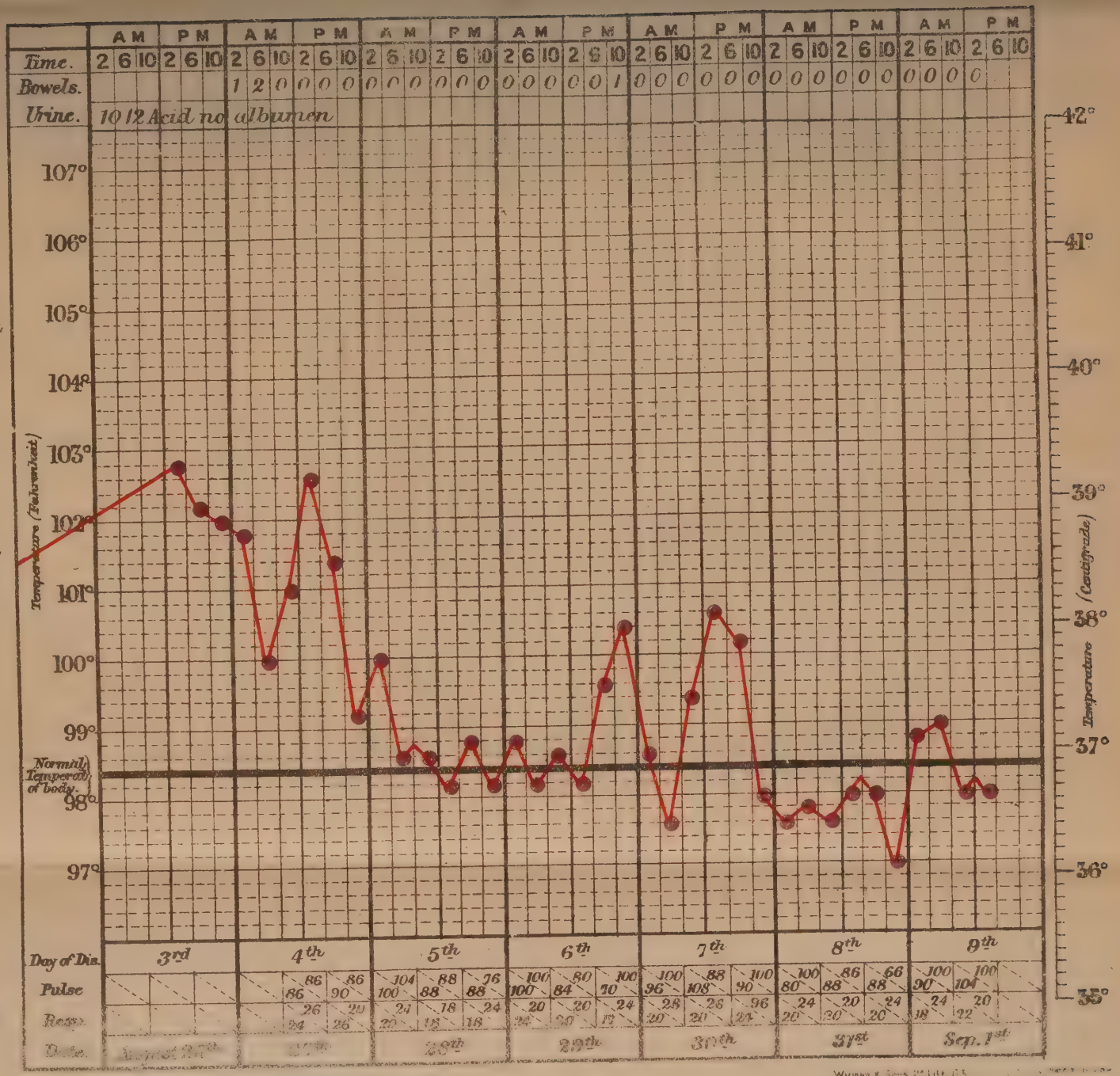
Name Martha T.

Age 58.

Diet. When illness began
W.H.I. with Milk
0 "η Extra.

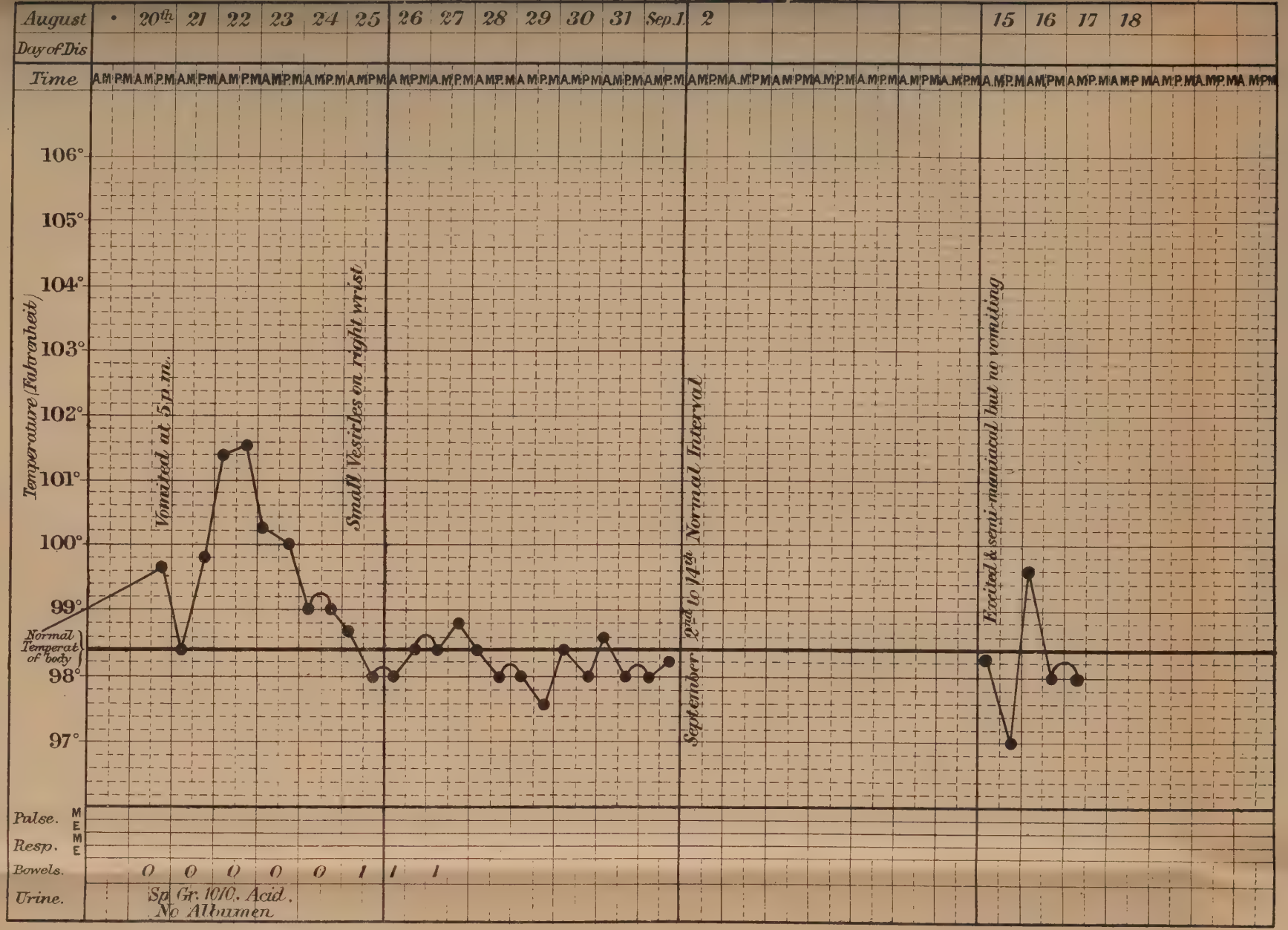
Rash appeared
August 24th

Date of admission.
26th August 1891.



Name, Hannah G.

Age 30.



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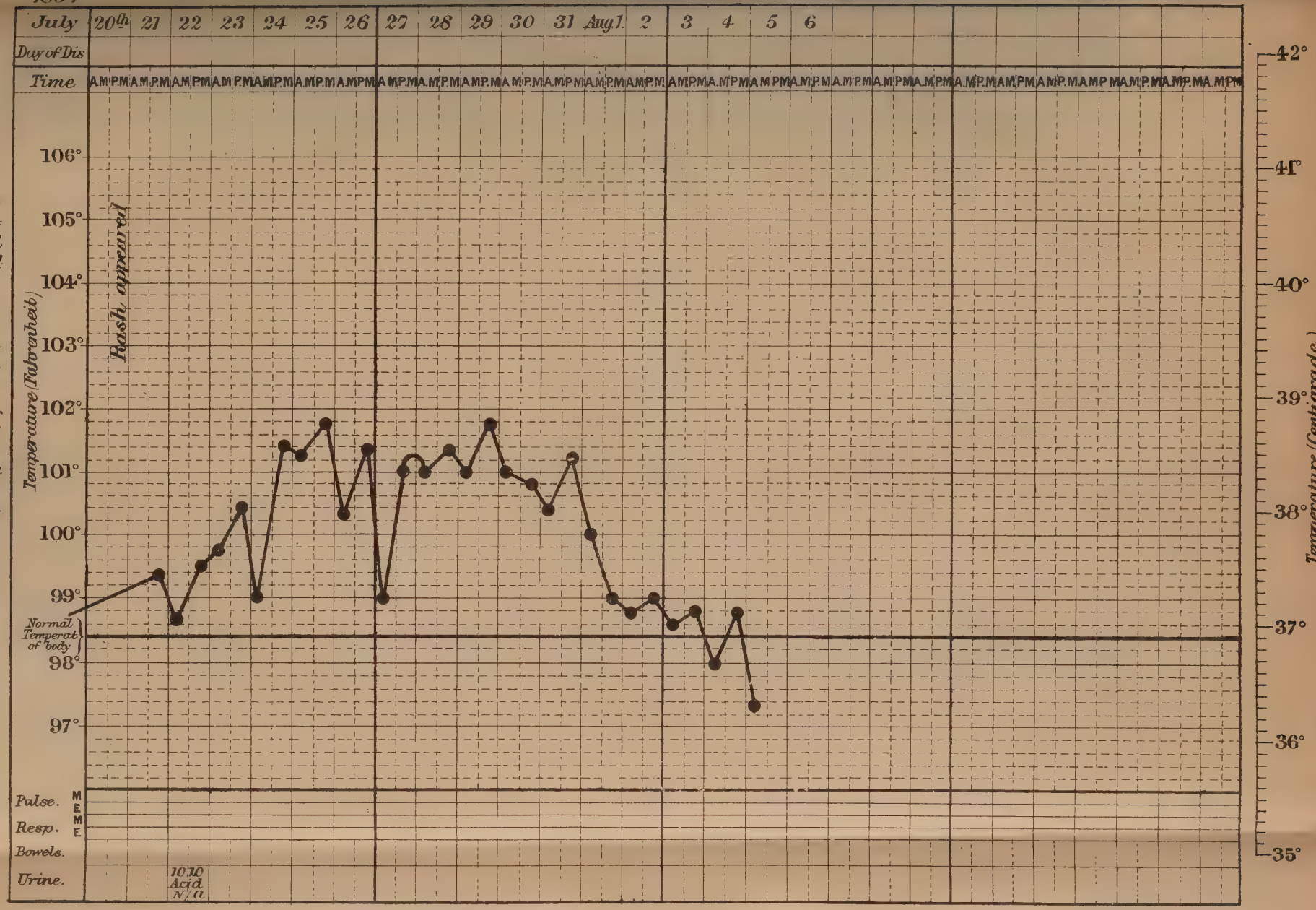
1894

CASE 6.

Name Pard

Age 27

A most marked case (moist type) of "Epidemic Skin Disease" but patient, a foreign jewess, did not appear to have headache &c, and took food fairly
Yet with typical rash and without any complication such as boils there was some considerable febrile disturbance.
She vomited a few times later on.
Her infant who had rash in the dry form had no appreciable rise of temperature.



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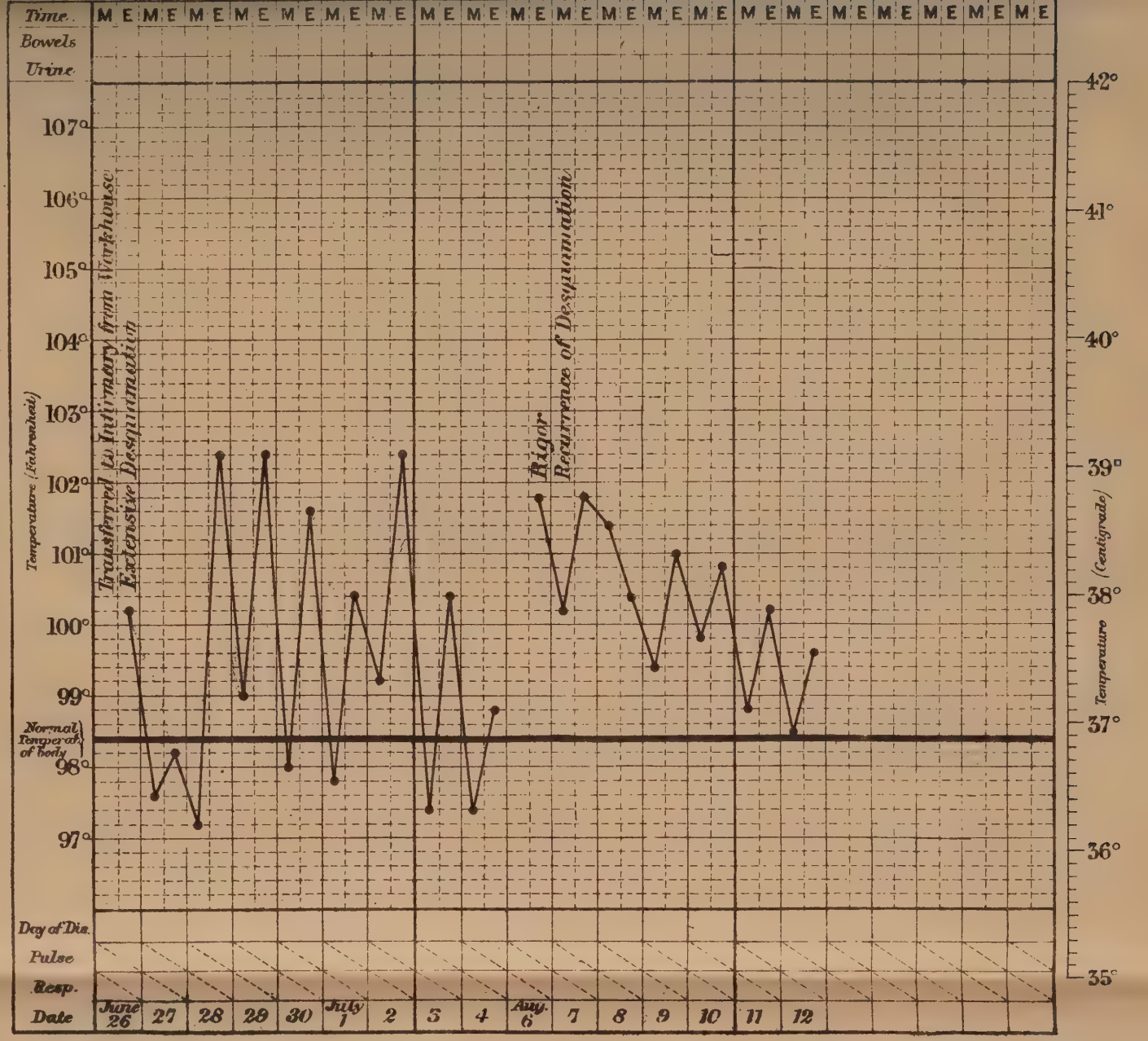
Name Emma E.

Age 66.

Three years ago had similar attack in this infirmary.



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ST. MARY ABBOTTS INFIRMARY KENSINGTON.

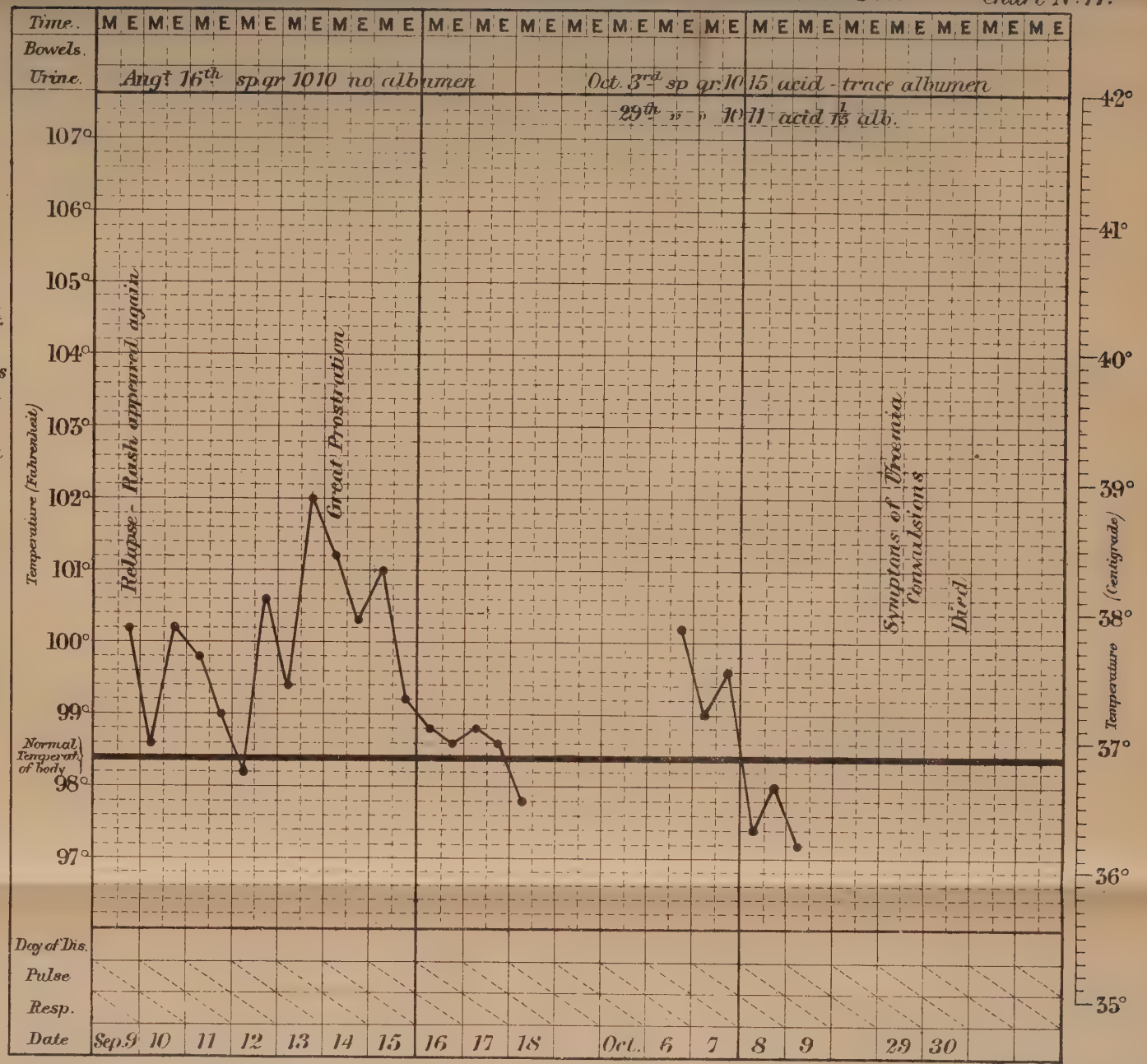
Chart N°11.

Name Sarah A.

Age 33.

Admitted Aug. 16th 1894.

Fourteen days before admission had rash accompanied with itching & followed by extensive peeling of skin of hands & feet



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ADDENDUM C.

St. George-in-the-East Infirmary.

Table showing the Number of Persons and of Cases of Epidemic Skin Disease at each of Certain Age Periods in the Infirmary during July, August, and September 1894.

Ages.	1 to 9.		10 to 19.		20 to 29.		30 to 39.		40 to 49.		50 to 59.		60 to 69.		70 to 79.		80 to 89.		Totals of all Ages.	
	M.	F.	M.	F.	M.	F.	M.	F	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
Number of persons under treatment in Infirmary at each age - -	58	55	8	17	26	43	32	50	67	37	38	43	64	65	27	62	4	17	324	389
Number of persons affected with the epidemic skin disease - - -	2	4	0	1	1	3	6	7	11	7	6	7	10	7	4	6	1	1	41	43
Ratio of cases of the disease to inmates of Infirmary at each age; per cent. -	3·45	7·28	0·00	5·88	3·85	6·99	18·60	14·00	16·4	18·95	15·8	16·3	15·65	10·79	14·85	9·69	25·00	5·89	12·65	11·05
Proportion attacked in both sexes combined; per cent. - - -	5·30		4·00		5·8		15·8		17·3		16·05		13·18		11·25		9·5		11·7	

This table is based on the number of separate individuals who passed through the Infirmary during July, August, and September. The cases of skin disease are those which occurred in the Infirmary only. The Infirmary officers are not included either among "inmates" or among cases of skin disease.

ADDENDUM D.

PARTICULARS as to CASES of EPIDEMIC SKIN DISEASE occurring in the ST. GEORGE-IN-THE-EAST INFIRMARY.

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R	S., Margt.	70	F.	I. C. 4 F.	16.3.94	1894. 3rd July	Sept. 1st to B.S.B.	No. 4	Right hemiplegia.	Feeble	1894. Still under treatment.			Rash only noted on Aug. 9th, then desquamating. The relapse was erythematous, and followed by large flakey scaling. Skin well again by Oct. 18th.
O	L., Rebecca	62	F.	I. B. 4	4.6.92	3rd „	Not isolated.	No. 1	Gout (quiescent).	Good health.	Recovery, 20th July.			July 3rd—Anorexia, severe headache. Vomited from July 9th to 13th. Not febrile.
O	L., M. A.	68	F.	I. C. 4 F.	27.6.94	5th „	„	No. 3	Ch. bronchitis, cardiac dilatation.	Feeble	+ Died 8th Aug.			Had influenza-like attack of pains all over, &c. Got congestion of the lungs and died. Prior to this was doing well.
R	P., Alfred	7	M.	I. D. 4	31.5 94	6th „	„	No. 4	Tubercular glands.	„	Recovery by Sept. 1st.			July—Vomiting, &c. Rash—urticarial and papular. Rash not till 15 Aug. 1894.
O	C., Wm.	46	M.	I. C. 4 M.	14.12.93	6th „	„	No. 3 eggs i.	Bronchial asthma.	Good	Recovery in a few weeks.			Had complete anorexia and foul dirty tongue.
R	W. House, Asst. Matron.	50	F.	W.		8th „	„	Officers'	None	„	End of Aug.			Began "rheumatism" and pains in head, &c. No appetite. Then beginning of August papular rash appeared.

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						1894.					1894.			
O	W., Annie	8/12	F.	I. C. I.	6.7.94	12th July	Not isolated.	4a	Dyspepsia	Feeble	Recovery, 27th July.	- -	- -	Vomiting, diarrhœa. Febrile and bronchial catarrh and urticaria on 12th July.
O	S., Michael	7/12	M.	I. C. I.	17.3.94	12th „	„	4a	Malnutrition	Poor	Recovery, 1st Aug.	- -	- -	Vomiting and bronchial catarrh.
O	K., Rose	35	F.	I. B. 4	18.11.92	12th „	„	No. 4	Ch. rheumatism.	Anæmic.	Recovery, 20th July.	- -	- -	Febrile. Anorexia, tongue dryish. Breath foul.
O	B., Rebecca	6/12	F.	W. Nursery.	13.7.94	13th „	„	Infants'	None	Good	Recovery 1st Sept.	- -	31.1.94	Both these children had bronchial catarrh, and vomited much, &c. Not febrile on admission. C. afterwards had general desquamation of the skin.
R	C., Edward	1	M.	W. Nursery.	13.7.94	13th „	Sept. 1st, B.S.B.	Infants'	„	„	Recovery, 22nd Oct.	- -	15.6.94	
O	F., Wm.	71	M.	I. D. 4	11.6.92	13th „	Not isolated.	No. 1	Senile cataract (operated and cured).	„	Recovery in a few days.	- -	- -	Rash, chiefly urticaria, with a few papules about arms. He felt giddy and unwell.
O	D., Thos.	32	M.	I. A. 4	14.6.91	13th „	„	No. 1	Old spinal injury and paraplegia.	„	− Died 26th July.	- -	- -	Vomited slightly febrile, no appetite, tongue dry, breath foul.
O	S., Catherine	68	F.	W. No. 41	14.7.94	14th „	„	W. H. H., milk, two pints extra.	Ch. bronchitis	Feeble	+ Died 10th Aug.	- -	1.11.90	Had albuminuria, vomiting, congestion of lungs, and cardiac failure.
O	W., Mary	4	F.	I. C. I.	23.6.94	16th „	„	3a *and* Nestlé's milk.	"Head nodding," &c.	Fair	Recovery, 27th July.	- -	- -	16th July—102° F. Bronchial catarrh, vomited, &c.

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O	D., Bridget	32	F.	W. No. 42	16.7.94	1894. 16th July	Not isolated.	W. H. II.	Epilepsy	Good	1894. Recovery, 9th Aug.		26.4.89	Was "flitty" and strange in manner. Febrile, 103° F. Bronchial catarrh. Vomited frequently, offensive vomit. No diarrhœa. Headache.
O	J., Chas.	40	M.	I. A. 4	23.8.93	16th ,,	,,	No. 1	Gout (quiescent).	Rather feeble.	+ Died 5th Aug.			Anorexia and bodily debility and mental depression set in. He gradually got worse. His hair all came out. He became sick had diarrhœa and died.
R	Sa, Esther	4½	F.	I. B. I.	1.7.94 (born).	19th ,,	July 20. B. 5. Sept. 1 B. S. B.	No. 3a	New born child.	Good	Recovery, 20th Sept.			Rash took dry type, and a tendency to *ringed form*.
R	S., Pard	27	F.	I. B. I.	1.7.94	20th ,,		No. 3	Labour	,,	Recovery, 16th Sept.			Severe case of moist type, with slight fever 102° F.
O	K., John	50	M.	I. C. 4 M.	20.6.94	20th ,,	Not isolated.	No. 3	Slight dementia.	,,	Recovery, 25th Aug.			Complete anorexia with fever, cream in man who generally ate ravenously, 31st Aug., forehead "scaly," but no positive rash.
O	B., David	61	M.	I. A. 4	7.7.94	20th ,,	,,	No. 1	Quiescent, 6 blood phthises	Fair	Recovery, 6th Aug.			Diarrhœa, vomiting, off food. Slight hæmoptysis.
O	D., Danl.	47	M.	I. D. 4	21.6.94	21st ,,	,,	No. 3	Ulcered leg	Good	+ Died 30th July			Vomited 21st July 1894. Headache and severe epistaxis. He became febrile, very sick and died rather suddenly. Epistaxis began 27th July 1894.

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O	T., Henry	32	M.	I. D. 4	4.7.94	1894. 23rd July	Not isolated.	No. 1	Fracture ext. condyle.	Good	1894 Discharged 30th July against advice.	-	-	23rd July 1894—Severe headache. Temp., 100·2°, 101°, &c. 27th July 1894—Bronchitis, right apex. 28th July 1894—Vomited. Very restless and depressed.
O	N., M. A.	53	F.	I. C. 4 F.	24.7.94	4th Aug.	„	No. 3	Ch. nephritis	Ill	+ Died 9th Aug.	-	-	4th August, vomited and had diarrhœa. Prior to this she had much improved.
R	H., Ellen	60	F.	I. B. 4	14.5.94	24th July	„	No. 3	Cardiac debility.	Good	Recovery, 21st Aug.	-	-	Severe headache, backache, &c. July 3—Diarrhœa. July 24—Anorexia, &c. Petechial rash legs later.
O	F., M. A.	66	F.	I. B. 4	2.11.91	24th „	„	No. 4	„	„	Recovery, 10th Aug.	-	-	Complained of debility and no appetite, and looked very ill. No fever. Heart failure.
O	A., Margt.	80	F.	I. B.S.B.	23.8.92	24th „	„	No. 3, eggs i., milk i.	Senectus	Feeble	+ Died 7th Aug.	-	-	Anorexia, &c. No rash. Hæmaturia on July 26th 1894.
O	Nurse B.	26	F.	I.	-	25th „	„	Nurses'	Well	Good	Recovery in about a couple of weeks.	-	-	Headache, pain in limbs, febrile, very prostrate. Not sick. No diarrhœa.
O	C., Ellen	69	F.	W. No. 41	25.7.94	25th „	„	II., milk i. extra.	Ch. bronchitis	Feeble	+ Died 2nd Aug.	-	2.10.90	Had influenza-like symptoms. No skin rash. No note as to vomiting.

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R	O., Jas.	47	M.	I. C. 4 M.	7.5.94	1894. 27th July	Not isolated.	No. 1, milk ; extra.	Fistula in ano	Good	1894. Recovery, 25th Aug.	.	.	Rash which was not general and not popular, appeared 30 Aug. 1894. Patient left Infirmary 3rd Sept.
R	S., Thos.	73	M.	I. C. 4 M.	7.8.94	27th ...	...	No. 1	Tubercular glands.	...	Recovery, 1st Sept.	.	.	Headache, sweating, and pyrexia on 11th Aug. when rash popular eruption appeared.
O	B., Isaac	61	M.	I. C. 4 M.	6.10.93	27th ...	...	No. 3	Senility	Fair	Died 30th July	.	.	Bronchitis, delirium, and death.
R	N., James	84	M.	I. C. 4 M.	13.3.94	28th ...	...	No. 4	...	...	Died 21st Aug.	.	.	Very acute, restless, and delirious. Aug. 15th Began to vomit. Abdomen distended. Died 21st Aug.
O	A. J. S.	42	M.	I. A. 1	27.7.94	28th ...	...	No. 3	Bronchitis	Good	Recovery, 9th Aug.	.	.	Patient was ... [illegible] ...
O	K., Hannah	77	F.	I. C. 4 F.	28.12.93	28th ...	...	No. 4	Senility	...	Died 31st July	.	.	Heart ... [illegible] ...

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R	C., Catherine	36	F.	I. B. 4	19.6.94	28th July	Sept. 1st, B.S.B.	No. 4	Lead colic	Good	Recovery, 10th Sept.	-	-	Semi-isolated in B. 5 for time. Rash, 11th Aug. 1894.
O	F., Elizabeth	45	F.	I. B. 4	26.7.94	28th „	Not isolated.	No. 4	Rheumatism	Ill and weak.	− Died 7th Aug.	-	-	Did well for first two days, and then attacked with vomiting and prostration and dry tongue, &c. Without doubt a superadded toxæmia.
R	R., Esther	19	F.	I. B. 5	10.7.94	28th „	Sept. 1st, B.S.B.	No. 3	Gonorrhœa	Good	Discharged cured, 5th Sept.	-	-	Urticarial rash forearms and body, only lasted few days; but papular on hands, which desquamated.
O	R., Eliza	67	F.	I. B.S.B.	29.5.94	29th „	„	No. 1	Quiescent fibroid phthisis.	Feeble	Sept. 27th, well	-	-	Had headache, backache, and pains in limbs, &c. Vomited and had diarrhœa. *Hæmaluria*, 4th Aug. 1894.
R	D., Sarah	41	F.	I. B.S.B.	5.8.93	29th „	„	No. 3	Ch. rheumatism.	Good	Recovery, 1st Sept.	-	-	Rash, Aug. 20th, 1894, urticarial with a few papules.
R	D., John	32	M.	I. A. 4	28.11.93	30th „	Sept. 1st, A. 5.	No. 3, fish, egg, cocoa.	Phthisis	Feeble	Recovery, 7th Oct.	-	-	August 21st—Severe vomiting and abdominal pain, hæmoptysis and hæmatemesis.
O	A., Michael	62	M.	I. C. 4 M.	2.4.94	30th „	Not isolated.	No. 4	Fistula in ano	„	+ Died 15th Aug.	-	-	Flushed face, febrile, bronchitis and cardiac failure.
R	B., Wm.	42	M.	I. C. 4 M.	5.4.94	30th „	„	No. 4	Hemiplegia	Fair	− Died 19th Aug.	-	-	Rash in August on forearms.

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O	Med. Superintendent.	29	M.	I. - -	- -	1st Aug.	Not isolated.	Usedtotake good deal of milk.	None -	Good	Recovery in about $\frac{3}{4}$.	- -	- -	Febrile for three days.
O	B., Rosina -	53	F.	I. C. 4 F.	11.1.92	2nd „	„	No. 1 -	Epilepsy -	„	Well in about a week.	- -	- -	Headache, pain in abdomen and off food. Febrile for few days. Vomited. Diarrhœa.
O	B., Sarah -	45	F.	I. B.S.B.	19.6.94	2nd „	Sept. 1st, B.S.B.	No. 4 -	Heart disease	Feeble	Recovery, 27th Sept.	- -	- -	Felt sick, but did not vomit. Febrile, 101° F. Albuminuria, 2nd Aug. 1894.
R	Laundry-maid (Neil).	22	F.	I. - -	Many months ago.	2nd „	Not isolated.	Officers' -	None - -	Good	„ „	- -	- -	No premonitory symptoms. Rash first. Became very weak in Sept. Not sick.
R	Nurse Munro.	22	F.	I. - -	„	2nd „	„	„ -	„ - -	„	Lasted about 3 weeks.	- -	- -	No premonitory symptoms before rash. General health good. Not sick.
R	Nurse Dawson.	24	F.	I. - -	„	2nd „	„	„ -	„ - -	„	Lasted about 6 weeks.	- -	- -	Began—headache, vomiting, and diarrhœa. Febrile. Very prostrate for some time. Rash on legs on 14th Aug. 1894.
R	H., Ann -	70	F.	W. No. 42	3.8.94	3rd „	Sept. 1st, B.S.B.	II. - -	„ - -	„	Recovery, 21st Sept.	- - -	11.4.78	General health good.
O	C., M. A. -	73	F.	I. A.S.B.	2.7.94	3rd „	Not isolated.	No. 3 -	Injury to chest	Fair	+ Died 8th Aug.	- -	- -	Progress well till Aug. 3rd, when seized with influenza-like symptoms.

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R	W., Joseph	54	M.	I. A. 4	21.2.94	4th Aug.	Not isolated.	No. 1, eggs ii., stout vi.	Stricture	Good	Recovery, Sept. 1st.	- -	- -	Had a typical influenza-like attack, with early vomiting, and then rash on 17th Aug. *Epistaxis.*
O	W., Ellen	63	F.	I. A. S. B.	9.1.94	4th „	„	No. 4	Ch. bronchitis and albuminuria.	Fair	− Died 13th Aug.	- -	- -	Sudden vomiting, and influenza-like symptoms set in.
O	C., Hannah	27	F.	W. No. 29	8.2.94	4th „	„	No. 4	None	Good (pregnant).	Recovery, 28th Aug.	- -	About July 21st, 1890.	Febrile. Vomiting and diarrhœa, &c.
O	W., David	27	M.	I. D. 4	13.7.94	4th „	„	No. 1	Ulcer of foot	Good	Discharged well, 23rd Aug.	- -	- -	Very sick and anorexia.
O	M., Maurice	40	M.	I. D. 4	31.7.94	4th „	„	No. 1	Phthisis	Fair	Discharged improved, 7th Sept.	- -	- -	Vomited.
O	W., Amelia	58	F.	I. A. S. B.	25.6.94	4th „	„	No. 4	Debility	„	Recovery, 20th Aug.	- -	- -	Acute headache, vomiting, febrile. Never any rash.
O	P., William	40	M.	I. A. 4	3.8.94	5th „	„	No. 3	Retention of urine.	Good	Discharged, 20th Aug.	- -	- -	Headache, backache. No appetite. Febrile. No rash.
R	W.H. Labour Master.	35	M.	W.	- -	5th „	„	Officers'	Well	„	Recovery, 20th Sept.	- -	More than year in service.	5th Aug.— Influenza-like symptoms. 21st Aug.— Rash.
O	K., Bridget	38	F.	I. B. 4	18.7.94	5th „	Sept. 1st, B. S. B.	No. 1	Lead colic	Fair	Recovery, 10th Sept.	- -	- -	Never any rash. *See* note. But herpes at *angle of mouth.*
O	Nurse Hennessey.	22	F.	I.	- Months ago.	5th „	Not isolated.	Officers'	Well	Good	Left infirmary in few days.	- -	- -	Febrile, vomited, and diarrhœa. Very flushed face. No rash. Very prostrate.

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O	H., Henry -	68	M.	I. D. 4 -	27.5.94	6th Aug.	Not isolated.	No. 1 -	Ulcered leg -	Good	+ Died 14th Aug.	- -	- -	Begun with diarrhœa, then vomited. Hiccough, congestion of the lungs, &c.
O	C., Geo. -	52	M.	I. D. 4 -	31.7.94	6th „	„	No. 1 -	„ -	„	Recovery, 20th Sept.	- -	- -	5th Sept. — Petechial "rash" on legs; but there was no real eruption. No fever. Vomited much at onset.
O	F., Robert -	54	M.	I. A. 4 -	6.8.94	6th „	„	No. 4 -	Bronchitis -	Feeble	− Died 22nd Aug.	- -	- -	This man was not sick, and had no diarrhœa, but he became extremely prostrate without sufficient cause.
O	W., Harriet	73	F.	I. A. S. B.	21.7.94	6th „	„	No. 4 -	Paralysis	„	Recovery, 3rd Sept.	- -	- -	Complained of pain in legs, &c. Anorexia. Pain in chest. Temp., 99° F.
R	C., Ann -	51	F.	I. B. 4 -	19.10.89	6th „	„	No. 4 -	Hemiplegia -	„	+ Died 13th Aug.	- -	- -	Papular rash forearms, which desquamated. Tongue became dry. She had complete anorexia, and died with influenza-like symptoms.
O	K., Catherine	75	F.	W. 42 -	6.8.94	6th „	„	II. -	Senectus -	„	+ Died 14th Aug.	- -	31.7.93	Influenza-like attack.
R	F., Robert -	61	M.	I. A. 4 -	5.8.94	7th „	„	No. 1 -	Cardiac weakness.	Good	Recovery, 20th Oct.	- -	- -	Not febrile at first. Rash earliest symptom, and very extensive. Severe vomiting and hæmatemesis in Sept.

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R	E., Agnes, laundry maid, but off duty.	21 (abt.)	F.	I. - -	- -	1894. 7th Aug.	Not isolated.	Officers' -	Injury to arm	Good	1894. Recovery, 30th Aug.	- -	- -	Papular rash on forearms only.
O	L., Ann -	81	F.	W. 42 -	8.8.94	8th „	„	II. -	Senectus -	„	Recovery, 1st Sept.	- -	11.4.94	Diarrhœa and sickness. Febrile. No rash.
R	C., Robt. -	38	M.	I. D. 4 -	31.12.94	9th „	Sept. 1st, A. 5.	No. 4, eggs i	Phthisis -	Fair	Recovery, 17th Sept.	- -	- -	9th August, sick and unwell. 13th, rash (erythematous and Rothelnlike), lasted till 21st August.
R	S., Ed. -	30	M.	I. D. 4 -	6.10.93	9th „	Not isolated.	No. 1 -	Ulcered legs -	Good	Recovery, 28th Aug.	- -	- -	Not sick. Did not vomit. But had a marked erythematous rash which desquamated.
O	C., Ellen -	26	F.	I. A. S. B.	8.8.94	9th „	„	No. 4 -	Heart disease	„	Discharged, cured, 21st Sept.	- -	- -	Was febrile, with headache, &c. But no rash. Very sick.
O	F., John -	76	M.	I. D. 4 -	20.6.94	9th „	„	No. 4 -	Fractured hip	Feeble	− Died, 14th Aug.	- -	- -	Progressing most favourably till he vomited and became febrile and got congestion of lungs.
O	D, John -	48	M.	I. D. 4 -	10.8.94	10th „	„	No. 3 -	Hæmorrhoids	Good	Discharged 28th Aug., improved.	- -	- -	Gastric pain and vomiting, and he passed much blood with stool.
R	H., Catherine	26	F.	I. C. 4 F.	23.6.94	10th „	Sept. 1st, B. S. B.	No. 1 -	Alcoholism -	„	Recovery, 21st Sept.	- -	- -	Papular rash, forearms and hand, Aug. 10th, 1894. Was ill and off food for some time.
O	D., Mary -	52	F.	I. A. S. B.	25.6.94	10th „	Not isolated.	No. 4, milk i.	Debility -	Fair	Discharged 22nd Aug., improved.	- -	- -	

R = Rash. O = without Rash.	Name.	Age.	Sex.	No. of Ward in which Patient was at Date of Attack. I = Infirmary. W = Workhouse.	Date of Admission to Infirmary.	Date of Appearance of Eruption or of other Symptoms if no Rash.	Date of Removal to other Ward, with No. of Ward to which removed.	Diet of Patient at Date of Attack, with Extras, if any.	Previous Malady from which suffering.	General Condition of Patient prior to Attack.	Date of Recovery or Death.	If admitted with Disease, where from.	If occurring in Workhouse, Date of Admission to Workhouse.	Other Remarks, &c. + The plus sign opposite a Death indicates that the Epidemic was the direct cause of Death. − The minus sign that it was only an auxiliary cause.
R	S., Elizabeth	49	F.	I. B. 4	18.6.94	1894. 10th Aug.	Sept. 1st, B. S. B.	No. 1	Abrasion of cornea.	Good	1894. Sept. 30th, cured.	- -	- -	Febrile headache. Foul tongue and breath. No appetite for few days. Then 20th August, blotchy erythema on chin, &c.
O	D., Julia	52	F.	I. B. 4	3.8.94	10th „	Not isolated.	No. 3	Heart disease	Feeble	− Died, 12th Sept.	- -	- -	Vomited a good deal. No rash.
R	Infirmary matron.	—	F.	I.	Years in service.	10th „	- - -	Officers'	Well - -	Well	Recovery in few weeks.	- -	- -	Papular itchy rash on legs noticed in August. Prior to this not feeling well.
R	W., Catherine	75	F.	I. B. 4	6.4.94	10th „	Not isolated.	No. 1	Hemiplegia -	Good	+ Died, 17th Aug.	- -	- -	Appetite poor for some time. Not vomiting. Hair coming out. Developed bronchitis and died.
O	P., George	67	M.	I. D. 4	7.8.94	11th „	„	No. 4, milk i.	Broncho-pneumonia.	Febrile and ill.	− Died, 16th Aug.	- -	- -	Became very sick 11th, vomiting on 12th and 13th, &c., and had very offensive diarrhœa. Urine, 1020, albuminous.
O	W., Ed.	74	M.	I. A. 4	11.8.94	11th „	„	No. 3	Bronchitis -	Very feeble.	− Died, 26th Aug.	- -	- -	This patient was ill on admission. But he developed rigor and vomiting attack which could only be explained on the ground of the epidemic.

R = Rash. O = without Rash.	Name.	Age.	Sex.	No. of Ward in which Patient was at Date of Attack. I = Infirmary. W = Workhouse.	Date of Admission to Infirmary.	Date of Appearance of Eruption or of other Symptoms if no Rash.	Date of Removal to other Ward, with No. of Ward to which removed.	Diet of Patient at Date of Attack, with Extras, if any.	Previous Malady from which suffering.	General Condition of Patient prior to Attack.	Date of Recovery or Death.	If admitted with Disease, where from.	If occurring in Workhouse, Date of Admission to Workhouse.	Other Remarks, &c. + The plus sign opposite a Death indicates that the Epidemic was the direct cause of Death. − The minus sign that it was only an auxiliary cause.
O	D., Rd. -	40	M.	I. A. 4 -	10.8.94	1894. 11th Aug.	Not isolated.	No. 3 -	Rheumatism	Good	1894. Recovery by 1st Sept.	- -	- -	Vomited and appeared very unwell without any other cause than the epidemic. Slightly febrile.
O	W., Mary -	46	F.	I. A. S. B.	8.8.94	11th „	„	No. 3, eggs i., milk ii.	Broncho-pneumonia.	Febrile and ill.	− Died, 2nd Sept.	- -	- -	Severe vomiting.
O	C., Catherine	37	F.	I. C. 4 F. -	14.1.84	12th „	„	No. 3 -	Epilepsy and ch. osteo-arthritis.	Good	Recovery by 1st Oct.	- -	- -	Febrile and off food with exacerbation of the Rh. process. Did not vomit. Very sleepless and restless.
R	C., Thomas	60	M.	I. C. 4 M.	17.8.93	12th „	Sept. 1st, C. 5.	No. 1 -	Hemiplegia -	„	+ Died, 15th Sept.	- -	- -	Extensive papular and erythematous rash. Took food well up to the last. Was demented now. Had apoplectiform attack before death.
R	M., Jas. -	67	M.	I. C. 4 M.	5.4.94	12th „	„	No. 3 -	Dementia after injuries.	„	Recovery, 20th Sept.	- -	- -	Whealy and papular rash. Not febrile. Boil in axilla. Carbuncle on back. Diarrhœa. Only vomited once or twice.
R	W., John -	45	M.	I. A. 4 -	25.10.93	13th „	„	No. 3 -	Deformed ankle from injuries, &c.	Fair	Died, 26th Sept.	- -	- -	Anorexia and mental depression. At length forehead became scaly, and petechiæ over body.

R = Rash O = without Rash.	Name.	Age.	Sex.	No. of Ward in which Patient was at Date of Attack. I = Infirmary, W = Workhouse.	Date of Admission to Infirmary.	Date of Appearance of Eruption or of other Symptoms if no Rash.	Date of Removal to other Ward, with No. of Ward to which removed.	Diet of Patient at Date of Attack, with Extras, if any.	Previous Malady from which suffering.	General Condition of Patient prior to Attack.	Date of Recovery or Death.	If admitted with Disease where from.	If occurring in Workhouse, Date of Admission to Workhouse.	Other Remarks, &c. + The plus sign opposite a Death indicates that the Disease was the direct cause of Death. – The minus sign that it was only an auxiliary cause.
R	B., Henry -	46	M.	I. D. 4 -	23.6.94	1894. 13th Aug.	Not isolated.	No. 1 -	Eczema on legs and front of elbows.	Good	1894. Recovery, 3rd Sept.	- -	- -	Discharged 3rd Sept. 1894, except as regards the disease but the eruption on hand & elbows quite well. Urinanalysis negative, 18th Aug.
R	P., M. A. -	56	F.	I. A. 8	28.6.94	14th „	Sept. 1st., B. S. B.	No. 1, eggs 1.	Albuminuria -	Fair	Recovery, 10th Oct.	- -	- -	Never stayed in previously. Delirious at first, but P. Afterwards forehead, &c. (scanty).
R	H. Marst. -	45	F.	I. B. 4 -	6.7.94	14th „	Not isolated.	No. 1 -	Hemiplegia -	Good	Discharged improved, at own request, 29th Aug.	- -	- -	Had 2 day attack and fell and got wet. Ambulate fairly for 10 days. Not feverish. Pyrexia afterwards & became weak and hands showed few desquamating patches.
R	B., Geo.	55	M.	I. D. 4 -	30.5.89	15th „	Sept. 1st. A. 5.	No. 4 eggs 1/2, milk 1.	Locomotor ataxia.	„	Recovery, 24th Sept.	- -	- -	N. [illegible] N. [illegible] rhoea. Rash A. [illegible] papular eruption on hands and forearms, 16th Aug., [illegible] urticaria. Not feverish.
O	E., Jas. -	63	M.	I. D. 4 -	28.4.94	16th „	Not isolated.	No. 1 -	Ch. bronchitis, cardiac asthenia.	Fair	+ Died, 3rd Sept.	- -	-	N. [illegible] Had been getting much better till 14th Aug. 1894. Rash petechiæ and ecchymosis beneath conjunctiva. A.
O	B., Wm. -	59	M.	I. D. 4	26.4.94	16th	„	No. 1 -	Ulcered leg	Good	Recovery, 17th Aug.	- -		Ulceration with which healed since [illegible]

R = Rash. O = without Rash.	Name.	Age.	Sex.	No. of Ward in which Patient was at date of Attack. I = Infirmary. W = Workhouse.	Date of Admission to Infirmary.	Date of Appearance of Eruption or of other Symptoms if no Rash.	Date of Removal to other Ward, with No. of Ward to which removed.	Diet of Patient at Date of Attack, with Extras, if any.	Previous Malady from which suffering.	General Condition of Patient prior to Attack.	Date of Recovery or Death.	If admitted with Disease, where from.	If occurring in Workhouse, Date of Admission to Workhouse.	Other Remarks, &c. + The plus sign opposite a Death indicates that the Epidemic was the direct cause of Death. − The minus sign that it was only an auxiliary cause.
						1894.					1894.			
O	H., Alice -	30	F.	I. B. -	6.8.94	16th Aug.	Not isolated.	No. 1, milk i.	Labour -	Good	Discharged 18th Aug. against advice.	- -	- -	Febrile and dirty tongue. Appetite bad. No rash.
O	M., Geo. -	34	M.	I. C. 4 M.	3.2.94	16th „	Sept. 1st, C. 5.	No. 3 -	Tertiary syphilis.	„	Recovery about 10th Sept.	- -	- -	Anorexia, with dirty tongue. Not febrile. Hair came out.
O	J., Jas. -	63	M.	I. D. 4 -	30.1.94	17th „ First seen.	Not isolated.	No. 3, chop i., egg ii., tea, sugar.	Cancer rectum.	Feeble	Recovery, 18th Aug.	- -	- -	Only a temporary urticaria.
R	P., Sophia -	70	F.	W. 30½ -	18.8.94	8th Aug.	Sept. 1st, B. S. B.	II. -	Nil - -	Good	Recovery, 10th Sept.	- -	17.8.94 and in prior to 11.7.94	This patient left workhouse about 11th July, and was re-admitted 17th Aug. 1894, with skin desquamating; disease evidently contracted in workhouse.
R	D., Wm.	53	M.	W. School	22.8.94	18th „	Sept. 1st, C. 5.	I. -	„ -	„	Recovery, 1st Oct.	- -	22.8.93	Kept well.
R	Nurse Simmons.	—	F.	W. - -	„	Not isolated.	- -	„ -	„	Well in about week.	-	Long in	Papular and urticarial rash. Hands and forearms and chest.
R	B., Margt. -	68	F.	W. No. 15	18.8.94	18th „	Sept. 1st, B. S. B.	II. -	„ -	„	Recovery, 11th Oct.	- -	27.2.89	Extensive rash about arms, hands, neck, body, and legs—dry.
R	R., Wm. -	69	M.	W. 44 -	22.8.94	19th „	Sept. 1st, C. 5.	II. -	Quite well -	„	Still under treatment.	- -	6.8.88	Married man. Sleeps with his wife at workhouse. She remains quite free.

R. Rash O. without Rash	Name.	Age.	Sex.	No. of Ward in which Patient was at Date of Attack. I.—Infirmary. W.—Workhouse.	Date of Admission to Hospital.	Date of Appearance of Eruption or of other Symptoms of the Rash	Date of Removal to other Ward with No. of Ward to which removed.	Date of Patient at Date of Attack, with Extras, if any.	Previous Malady from which suffering.	General Condition of Patient prior to Attack	Date of Recovery or Death.	If discovered while Disease where from.	If occurring in Workhouse. Date of Admission to Workhouse.	Other Remarks &c. + The post-mortem appears to a Death certificate that the Epidemic was the direct cause of Death. The Medical Officer said it was only secondary cause.
O	G., Hannah	30	F.	I. C. & F.	26.7.94	1894. 30th Aug.	Not isolated.	No. 1, eggs, milk,	Debility, mental and bodily.	Poor	1894. Recovery 30th Sept.			Aug. 26 Convulsive attack. Lost speech, hearing, sight, but it was Vomiting profusion then Aug. 28 Rigor mortis present, which lasted till Sept. 1st.
R	T., Martha	58	F.	W. 40	26.8.94	29th „	Sept. 1st, B. S. B.	IL., milken.	Ch. bronchitis		Recovery. 27th Sept. still feeble.		31.5.81	Febrile and very prostrate. Bronchial catarrh.
R	C., Lucy	3	F.	W. nursery	24.8.94	24th „	Not isolated.	M.lk I. E. W.H. III.	Well	Good	Discharged improving, to parents, 31st Sept.		17.8.94	Most typical Papular rash on ears, cheek, and extending ahead in scalp patches. Lesions of best. Rest of body quite free. Fever 103 4.11.
R	C., Prsik.	4	M.	W. nursery	25.8.94	25th „	Sept. 1st, B. S. B.		„	„	Recovery, 29th Sept.		8.8.94	Fine hemo papular rash, lesions and tasty.
O	R., M. A.	48	F.	I. B. 4	22.8.94	27th „	„	No. 3	Injury to knee	„	Recovery. 2nd Oct.			No [illegible] rash but fore-[illegible] symptoms very [illegible] [illegible] [illegible]

R = Rash. O = without Rash.	Name.	Age.	Sex.	No. of Ward in which Patient was at Date of Attack. I=Infirmary. W=Workhouse.	Date of Admission to Infirmary.	Date of Appearance of Eruption or of other Symptoms if no Rash.	Date of Removal to other Ward, with No. of Ward to which removed.	Diet of Patient at Date of Attack, with Extras, if any.	Previous Malady from which suffering.	General Condition of Patient prior to Attack.	Date of Recovery or Death.	If admitted with Disease, where from.	If occurring in Workhouse, Date of Admission to Workhouse.	Other Remarks, &c. + The plus sign opposite a Death indicates that the Epidemic was the direct cause of Death. – The minus sign that it was only an auxiliary cause.
					1894.						1894.			
O	M., Eliza -	69	F.	W. 30½ -	28.8.94	28th Aug.	Not isolated.	II. -	Well - -	Good	Still feeble (20th Oct.)	- -	27.1.93	Began with diarrhœa, then had rigor, and became very "dotty." Herpes on face, and afterwards skin very dry and suspicious.
R	R., Elizabeth	79	F.	W. 30 -	31.8.94	31st „	Sept. 1st., B. S. B.	II. -	„ - -	„	Recovery, 4th Oct.	- -	18.3.93	Erythematous rash, scalp, face and chest. Not febrile.
R	H., Henry -	5	M.	W. Receiving Ward.	31.8.94	31st „	„	III. -	„ -	„	Recovery, 3rd Sept.	These two were in W. H. from 20th Aug. to 24th Aug., and were then free from rash.	20.8.94 31.8.94	Papular rash, forearms, which, by Sept. 3rd, under eucalyptus treatment, had quite gone.
R	H., M. A. -	11	F.	W. Receiving Ward.	31.8.94	31st „	„	V. - -	„ -	„	Recovery, 6th Sept.	These two were in W. H. from 20th Aug. to 24th Aug., and were then free from rash.	20.5.94 31.8.94 &c.	Admitted with desquamating papules on hands, evidently of some days' duration.
R	D., Ellen -	6	F.	W. Receiving Ward.	31.8.94	31st „	„	Was in W. H. on Aug. 8th, and had bread and milk.	„ -	„	Recovery, 24th Sept.	- -	31.8.94	This child was brought by police to workhouse on Aug. 8th, and had bread and milk. Left same day. Rash very slight.
R	W., Satonia	65	F.	W. 41 -	17.9.94	3rd Sept.	„	II. -	„ - -	„	Recovery, 1st Oct.	- -	6.5.91	Patient did not mention rash till 17th Sept.

R or Read, O or without Rash	Name.	Age.	Sex.	No. of Ward in Which Patient was at time of Attack. I. Isolation-ary. W. Work-house.	Date of Admission to Isolation Hospital.	Date of Appearance of Eruption or of other Symptoms of the Rash.	Date of Removal to other Ward, with No. or Ward to which removed.	Date of Patient's last Attack. With Extras if any.	Previous Maternity from which suffering.	General Condition of Patient on Admission.	Date of Recovery or Death.	Days Isolated after Disease ceased from.	Days in Hospital or Work-house.	Other Remarks, &c.
						1894.					1894.			
O	J., Elizabeth	64	F.	I. B. 4	4.7.94	6th Sept.	Not isolated.	No. 1	Cancer, breast	Good	Recovery, about 12th Sept.	-	-	No rash.
O	M., Jas.	30	M.	W. No. 10	10.9.94	10th ,,	,,	I.	Nil	,,	Died 14th Sept.	-	8.9.94	No rash. But febrile with bronchitis and subsequently developed two prostrate conditions. Died with signs of congestion of lungs without any such complication.
O	M., Amelia	71	F.	W. 30	11.9.94	11th ,,	Sept. 15th	II.	Nil	Good	Recovery, 28th Sept.	-	2.4.94	No rash patient very much shaken. Slight bron- chitis remained for some time.
O	S., Sapina	66	F.	W. 15	13.9.94	13th ,,	,,	II.	,,	,,	Recovery, 28th Sept.	-	24.5.94	
R	R., Elizabeth	32	F.	W. 304	14.9.94	14th ,,	Sept. 14th B. S. B.	I.	Nil, confined 30.7.94	,,	Recovery, 11th Oct.		4.9.94	Disarticulated condition of Epidemic. Febr. for one or two
R	R., Jane	5	F.	W. nursery 4th day Sept. at night.	14.9.94	14th ,,	,,	Breast	Well	,,	Recovery, 11th Oct.		4.9.94	Profuse rashy over all over body, but chiefly arms and forearms.
O	K., Ellen	34	F.	I. B. I.	4.9.94	14th ,,	,,	No. 3	Confined 4.9.94, last other wise ward.	,,	Discharged, re- lieved 19th Sept. at his own request.	-	-	Febrile. But feels well, and no other
R	K., Polly		F.	I. B. I.	4.9.94	14th ,,	,,	Breast	Well	,,			-	Imperfect history of rash.
R	Nurse Wood	N.	F.	W.		19th ,,	Not isolated	Others'	,,	,,	Recovery, 26th Oct.		Yearsin	Typical clinical form. Rapidly and [illegible] arms, hands and forearms and developed desquamation [illegible]
R	W H Assistant Matrons daughter	18	F.	W.		23rd ,,	,,		,,		Not known owent away		13.9.94	In ward from 22nd Sept. 1894 to 23rd same as Nurse Wood, [illegible]

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St. Marylebone Infirmary, W.

Table showing the Number of Persons and of Cases of Epidemic Skin Disease at each of certain Age-Periods in the Infirmary, during June, July, August, and September 1894. (Calculated on Number of Persons in the Infirmary on June 1st, 1894, the date of commencement of Epidemic.)

Age.	1 to 9.		10 to 19.		20 to 29.		30 to 39.		40 to 49.		50 to 59.		60 to 69.		70 to 79.		80 to 89.		90 to 100.		Total at all Ages.	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
Number of persons under treatment at each age	24	26	14	15	36	22	32	27	49	37	55	45	62	67	36	59	9	16	2	3	319	317
Number of cases affected with the epidemic skin disease	1	—	—	—	1	—	2	2	9	3	9	1	8	10	10	7	4	2	—	—	44	25
Ratio of cases of the disease to inmates of Infirmary at each age; per cent.	4·1	—	—	—	2·8	—	6·2	7·3	18·3	8·1	16·3	2·2	12·8	15·0	30·6	12·0	43·3	12·5	—	—	13·8	7·8
Proportion attacked in both sexes combined; per cent.	2		—		1·7		6·8		14·0		10·0		13·4		17·7		24·0		—		10·8	

APPENDIX.

Particulars as to Cases of Epidemic Skin Disease occurring in the St. Marylebone Infirmary.

Ward.	Bed.	Name.	Age.	Where admitted from.	Date of Admission.	Date of Appearance of Rash.	Parts affected and Course.	1st, 2nd, or 3rd Attack.	Constitutional Symptoms.	Result.
A 1	17	Charlotte W.	76	W. H. C. Ward	July 31, 1894, with rash.	July 1, 1894	Palms and backs of hands, then general.	1st	Anorexia not very marked. diarrhœa four days.	Cured, Sept. 24, 1894.
A 1	18	Harriet L.	64	W. H. C. Ward	Aug. 8, 1894, with rash.	- - -	Elbows, then thighs and abdomen, much scaling.	1st	Anorexia and weakness.	Cured, Sept. 24, 1894.
A 1	8	Elizabeth C.	63	28, Wells Street	July 28, 1894, [illegible] face and inflamed glands in neck.	Sept. 7, 1894	Both elbows painful - - Condensed milk, Sept. 10.	1st	Rise of temp. due to other causes.	Duration, 11 days.
A 2	6	Mary A. C.	63	W. H.	Aug. 16, 1894, with rash.	About June 1894.	Right arm, leg, and body	1st	Anorexia and sickness	Sept. 22, much better, not yet disappeared.
A 2	12	Sarah S.	60	W. H. - -	- - -	- - -	Elbows.	—		
A 2	8	Mary A. B.	66	W. H. - -	- - -	- - -	Elbows.	—		
A 2	S. W.	Elizabeth B.	76	W. H. D. Ward	Sept. 3, 1894, with rash.	July 3, 1894	Both arms, back of neck, then general. Much itching and scaling. Condensed milk, Sept. 10.	3rd	None -	Sept. 22, not well yet
A 2	18	Isabella R.	78	W. H. G. Ward	Sept. 12, 1894, with rash.	July 12, 1894	Arms and legs [illegible] to commence scaling on body. Great scaling and weeping. Condensed M...K, no local treatment.	2nd	None	
A 2	19	Ann C.	56	W. H. 24	Sept. 13, 1894, with rash.		Greased. Much scaling and itching.	—	Not sensible on 24th [illegible] Albuminuria and uræmic fits	
A 3	26	Mary R.	68	10, Devonshire Street, Lesson Grove.	Jan. 17, 1894 -	Sept. 10, 1894	Front of elbows, also lower parts of back.	1st	None - - -	Cured, duration three weeks

Ward.	Bed.	Name.	Age.	Where admitted from.	Date of Admission.	Date of Appearance of Rash.	Parts affected and Course.	1st, 2nd, or 3rd Attack.	Constitutional Symptoms.	Result.
B 1	—	Dinah K., *alias* B.	60	4, Quebec Mews, S. M. B.	May 11, 1894, with catarrh of bladder.	Sept. 4, 1894 -	Back and hands papular -	—	None.	
B 1	19	Mary G. -	73	W. H. Pettiford's Hall.	May 16, 1894, with epilepsy and partial paralysis.	Sept. 11, 1894 -	Arms and face papular in character, itching.	—	No temp. No anorexia.	
B 2	S. W.	Johanna R.	46	21, Grays Bridge, S. M. B.	Aug. 30, 1894, with rash.	Middle of June, 1894.	First on feet, then back and chest, then hands. Lastly legs, where it was most severe.	1st	Anorexia and nausea after food.	Sept. 22, nearly well.
B 2	6	Louisa C. -	43	Saffby Shelter -	June 25, 1894 -	Aug. 2, 1894 -	Left foot, then legs and arms, then back, papular rash very slight. No scaling, great itching. Condensed milk, Sept. 13.	1st	Sickness and attacks of fainting.	Sept. 22, nearly well.
B 2	28	Annie H. -	38	9, Marylebone Lane.	July 23, 1894 -	Aug. 27, 1894 -	Arms, hands, then chest and legs, papular rash with subsequent scaling.	1st	None - - -	Sept. 22, rash not yet disappeared.
B 3	13	Elizabeth P.	87	W. H. 25a. -	Aug. 27, 1894, with rash.	Aug. 20, 1894 -	General granular at first, weeping, especially behind ears. Itching severe.	1st	Anorexia not marked, diarrhœa one day, great weakness.	Sept. 22, much better, not yet well.
B 3	19	Hannah C. -	69	9, Hereford Street, S.M.B.	Feb. 25, 1891, eczema,	Aug. 28, 1894 -	First on legs, then all over body and neck.	2nd	Temp. 102° F. once due to axillary abscess, otherwise normal.	Aug. 28, not quite well, axillary abscess.
B 3	15	Amelia W. -	73	45, Christian Union Almshouses.	June 8, 1894, fractured femur.	Sept. 13, 1894 -	Elbows first, then down front and back of forearms. Nowhere else.	1st	None - - -	Cured, duration two weeks.
B 3	S. W.	Ellen E. -	67	W. H. - -	Sept. 4, 1894, with rash.	- - -	Hands chiefly affected -	1st	No anorexia. No temp.	Sept. 23, insisted on going out, hands scaling profusely still.
C 1	16	Anne B. -	67	172, Great Titchfield Street.	June 12, 1894, with rash.	May 30, 1894 -	Body, arms, and face -	1st	Diarrhœa and albuminuria.	

Ward.	Bed.	Name.	Age.	Where admitted from.	Date of Admission.	Date of Appearance of Rash.	Parts affected and Course.	1st, 2nd, or 3rd Attack	Constitutional Symptoms.	Result
C 2	Cot.	John S. -	4	- - -	April 18, 1894, rickets.	Sept. 1, 1894 -	Papular rash on face	1st	- - -	Cured, duration three weeks; discharged Sept. 26
C 3	20	Catherine D.	77	1, Buckingham Street.	Aug. 24, 1894, with rash.	Aug. 16, 1894 -	Arms, then right thigh, becoming general excepting face. It went on to formation of small pustules, which ruptured and discharged copiously.	2nd	Great anorexia -	Cured, duration six weeks.
C 3	14	Sarah C. -	81	W. H. - -	Sept. 18, 1893 -	Aug. 17, 1894 -	Whole body at once. Began as papular eruption, body becoming redder day by day, till it was almost scarlet.	1st	None -	Sept. 22, rash still present, with some exfoliation
C 3	7	Jane L. -	40	7, Little North Street.	Aug. 14, 1894, rheumatism and dementia.	Sept. 10, 1894 -	Face and arms papular, very little scaling.	-	Slight anorexia.	
D 3	6	Alice W. -	35	27, Primrose Street, S. M. B.	Nov. 4, 1892, hemiplegia.	Aug. 17, 1894 -	Arms, hands, face, slightly on legs.	2nd	None	Cured, duration three weeks.
D 3	15	Eleanor S. -	79	25, Union Street	Jan. 1, 1893 -	June 20, 1894 -	Thighs only, but becoming general.	1st	None	Cured, duration one month.
E 1	18	Frederick C.	67	W. H. - -	June 15, 1894 -	Aug. 4, 1894 -	First on face and neck, then arms and front and back of body, general.	1st	Weakness and anorexia. Temp. normal.	Sept. 20 still slight papular rash on face.
E 1	5	James T. -	57	- - -	Feb. 22, 1892, with pemphigus	Aug. 4, 1894 -	Papular rash on forehead, then back and front of body, arms, legs and feet, becoming general	4th	Weakness, anorexia, and nausea	Cured, duration four weeks.
E 1	6	Samuel T. -	40	93, Newington Street, S. M. B.	Oct. 17, 1894	Aug. 21, 1894	Papular, starting on elbows, then forearms, trunk, legs and feet. Slight exfoliation. No rash on body.	1st	Anorexia and sickness	Cured, duration one month.

Aug. 4, Nov. 11.

Cases continued from previous table.

1894

Ward.	Bed.	Name.	Age.	Where admitted from.	Date of Admission.	Date of Appearance of Rash.	Parts affected and Course.	1st, 2nd, or 3rd Attack.	Constitutional Symptoms.	Result.
E 1	14	Samuel N.	82	W. H.	1889	Aug. 29, 1894	Papular rash on elbows and forearms, then higher up arms.	6th	Anorexia and weakness. No temp. No itching.	Cured, duration three weeks.
E 3	16	John C.	75	W. H., No. 6 Ward.	May 3, 1894	?	Rash on left foot on admission, spread to legs, then to arms, finally body and head.	—	None. Great itching	Sept. 21, rash nearly cleared up, still some on legs.
E 3	19	Frederick S.	66	W. H.	July 7, 1893, hemiplegia.	Aug. 18, 1894	First on back, neck, and chest, then legs, feet, arms, and hands. Condensed milk, Sept. 10th.	—		Sept. 29, still some rash.
E 3	9	Joseph H.	52		Nov. 1, 1893, sinus in thigh.	Aug. 24, 1894	First chest, then shoulders and legs in patches.	3rd	Itching, anorexia. Temp. has been high at times.	Cured, six weeks.
E 3	10	Thomas S.	47	Shaftesbury shelter.	May 24, 1894	Aug. 24, 1894	First on back and chest, then arms, hands, feet, and legs. Face not affected	1st	Temp. normal, anorexia not marked, much itching.	
E 3	S. W.	Frederick B.	71	W. H., No. 16	May 2, 1894	Sept. 5, 1894	Back and neck, then arms. Not general.	1st	Anorexia and nausea. Temp. normal.	Sept. 29, still slight rash on arms and legs.
E 3	13	George F.	45	142, Carlisle Street.	April 19, 1892	Sept. 5, 1894	First forearms, then abdomen and thighs. Nowhere else.	1st	None	Cured, duration three weeks.
F 1	4	James A.	56	S. A. Shelter, Lisson Grove.	Feb. 13, 1894	Aug. 21, 1894	Commenced on back of neck, the arms, and chest. Great itching.	1st	Anorexia	Cured, duration four weeks.
F 1	17	James B.	52	W. H., No. 6 Ward.	Nov. 24, 1894	Aug. 21, 1894	Forearms, then front and back of body, face, legs, and feet; much itching.	1st	Anorexia. Temp. raised on three evenings. Face much swollen, eyelids puffy. No albuminuria.	Duration four weeks, but some scaling later.
F 1	7	William G.	78	46, Church Street	July 6, 1891	Aug. 22, 1894	Forearms, legs, and feet, then forehead. None on body or above knees.	1st	Weakness and nausea	Cured, duration four weeks.

Ward.	Bed.	Name.	Age.	Where admitted from.	Date of Admission.	Date of Appearance of Rash.	Parts affected and Course.	1st, 2nd, or 3rd Attack.	Constitutional Symptoms.	Result.
I 2	21	Thomas V.	58	W. H.	June 16, 1890, with ulcerated leg and tubercular testis.	Aug. 16, 1894	Back of neck, then face, chest, arms, legs. Patient very red hand, spotty.	1st	Anorexia, sleepless, loss of flesh. Temp. high at the time, accounted for by tubercle.	Cured, duration 10 days, but scattered cases *Dundee Physician*, Sept 30th.
P 2	1	Arthur C.	40	May 18, 1894, [illegible] Dearmore Street, L. G.	- - -	Sept. 18, 1894	Papular rash, appearing first on extensor aspect of forearms, then on knees and ankles, then back. Nose and eyes slightly affected	—	Great anorexia, tremors. Temp. subnormal, diarrhœa one week.	Sept. 21, rash nearly all faded
P 3	7	William N.	6	54, Bell Street	Aug. 19, 1894, with hernia.	Aug. 28, 1894	Started on arms, neck, back, and legs. Face least early, rather thin papular. Condensed milk, Sept. 19th.	2nd	Severe conjunctivitis. Temp. 101 at one time. Great itching anorexia.	Cured, duration late weeks.
P 3	9	Edward H.	70	W. H., 16 B.	April 5, 1894, large prostate.	Sept. 5, 1894	Face and neck not general, not much swollen. Condensed milk, Sept 11th.	1st	None.	
P 3	6	Edward W.	48	- - -	Aug. 3, 1894, with ulcerated leg.	Sept. 11, 1894	Started on back of trunk and spread to outer side of face, Condensed milk, Sept. 11th.	1st	None	Cured, Sept 19th.
G 1	28	Henry H.	84	W. H.	Nov 24, 1893	Sept 2, 1894	Back and arms, then general. Condensed milk, Sept. 10th.	1st	Anorexia, Temp. subnormal.	Cured duration four weeks
G 1	9	William F.	73	54, Bell Street	Sept. 4, 1894, [illegible]	- - -	Papular rash on back of right hand.			Cured, Sept 20, 1894
G 1	24	Arthur M.	24	S. A. Shelter	May 4, 1894	Sept. 5, 1894	Red raised papular rash on [illegible] Severe eczema [illegible]	1st	None	Cured, duration two weeks
G 2	S. W.	James ?	30	6, Lassel Street	May 18, 1894	Aug. 4, 1894	Face hands and wrist, then feet. Condensed milk, Sept. 10th.	1st	Slight anorexia. Temp. hectic.	Cured, duration seven weeks.
G 2	29	Thomas S.	60		[illegible]	Aug. 20, 1894	Scaly rash on both arms, then legs, and spread all over body.	—	Almost complete anorexia.	*Died Aug. 25, 1894*

Ward.	Bed.	Name.	Age.	Where admitted from.	Date of Admission.	Date of Appearance of Rash.	Parts affected and Course.	1st, 2nd, or 3rd Attack.	Constitutional Symptoms.	Result.
G 2	25	William A.	44	86, Richmond Street.	July 25, 1894	Sept. 3, 1894	First on leg, then elbows, then back, spreading gradually. Condensed milk, Sept. 10th.	1st	Anorexia and sickness. Temp. normal.	Cured, duration four weeks.
G 3	11	Charles G.	64	- - -	April 30, 1894	July 3, 1894	From wrist upwards on face, back, legs last. Came in patches. A week before death the rash on legs became purpuric, the face peeled, and was scarlet coloured.	1st	Temp. sub-normal, great itching, conjunctivitis. Legs were œdematous.	*Died Sept.* 24, 1894.
H 1	S. W.	John B.	69	W. H., No. 5 Ward.	Aug. 23, 1894, with rash.	Aug. 14, 1894	Papular rash, came suddenly all over body at once. Condensed milk, Sept. 10th.	1st	Axillary abscess formed, great weeping and scaling.	Sept. 29, practically well, duration seven weeks.
H 1	22	Alfred G.	61	18, Burne Street	Feb. 2, 1894, bronchitis.	Aug. 30, 1894	Back and arms, papular exudation. Condensed milk, Sept. 10th.	1st	- - - -	Cured, duration four weeks.
H 1	6	James R.	56	W. H., No. 5	Sept. 4, 1894, with rash.	- - -	Back of hands and knees, on Sept. 18th; it came out on back and right side of neck.	—	No anorexia, itching before the rash. Temp. sub-normal.	Cured, Sept. 24, 1894.
H 1	13	Robert C.	71	- - -	Aug. 25, 1894	Not known	On hands only - - -	—	Developed pneumonia	*Died Sept.* 6, 1894.
H 1	14	Henry J.	68	27, Stafford Street.	Sept. 11, 1889	Aug. 18, 1894	First back, then legs and arms, then head. Condensed milk, Sept. 10th.	4th	- - - -	Sept. 29, very slight. Still on ankle.
H 1	15	Frederick M.	66	W. H.	Aug. 2, with the rash.	- - -	Both ankles, remained localised.	1st	None - -	Cured, duration five weeks.
H 2	10	Henry G.	83	- - -	Nov. 27, 1893, with asthma after admission.	About five months.	General - - - -	—	- - - -	*Died Aug.* 22, 1894.
H 2	20	Walter C.	42	- - -	July 13, 1893, with liver disease.	Aug. 22, 1894	Arms and knees, then elbows and body. Spread gradually. Great itching.	1st	Temp. normal. No alb.	Cured.

Ward	Bed	Name	Age	Where admitted from	Date of Admission.	Date of Appearance of Rash.	Parts affected and Course.	1st, 2nd or 3rd Attack	Concomitant Symptoms	Result.
H 4	S W	[illegible] F	72	-	May 10, 1894, for liver disease.	Aug. 10, 1894	General		[illegible]	Died Aug 13 1894
H 2	S W	[illegible] P	50	W H No. [illegible]	Sept. 11, 1894, with rash.	Three weeks before admission.	[illegible] wrist [illegible]	1st.	None	Sept 1st much better.
H 3	S W	William L	57	[illegible]	Sept. 2, 1894, [illegible]	?	Cutaneous papillae		None	Died Sept 4 1894
H 9	[illegible]	Robert B	39	W H No. [illegible] Ward	Died 4 1894	Jan. 1894	[illegible] Confluent [illegible] Sept 20th	3rd	Severe itching, severe conjunctivitis.	Sept. 29, still peeling greatly.
H 5	23	Charles W	48	[illegible]	Mar. [illegible] 1894	June 1 1894	Back [illegible]	1st.	Temp. subnormal	Duration two months.
H 3	7	Henry B	41	St [illegible] Hospital [illegible] Specialist	Dec 27 1894	July 4th 1894	Papular on [illegible] spread to [illegible] back [illegible] and shoulders Confluent, still Sept 29th	3rd	Temp. subnormal, severe conjunctivitis [illegible] days	Sept. 29, not quite well.
H 2	S W	[illegible]	35	[illegible]	[illegible] [illegible] admitted	[illegible]	Cutaneous	1	Patient [illegible]	Died Aug 25
H 8	S W	Henry F	27	W H No. 6 Ward	Aug 29 with rash	About Aug 8	General Confluent still Sept 29th	1st	Severe [illegible]	Sept. 29, slight desquamation
H 3	[illegible]	[illegible] M	31	S A [illegible]	Aug [illegible] 1894 [illegible]	Aug 21 1894	Papular [illegible] [illegible] Confluent [illegible] Sept 29th	1st	Pains in [illegible]	Desquamation [illegible]
H 8	22	[illegible] C	31	[illegible]	[illegible]	Sept 5 1894	[illegible] and Extremities		[illegible]	[illegible]
		[illegible]	[illegible]	[illegible]	[illegible]	Sept 5, 1894	[illegible]	[illegible]	[illegible] Hemorrhage from [illegible]	Desquamation [illegible]

J. R. [illegible]

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No. 12 and No. 12A.

COMPILATION of RETURNS of NOTIFIED CASES of CERTAIN INFECTIOUS DISEASES, and REGISTERED DEATHS therefrom.

APP. A. No. 12.

No. 12.

TABLE showing Quarter by Quarter, during the Year 1893, for each of REGISTERED DEATHS from the under-mentioned DISEASES, together SANITARY DISTRICTS in question.

The Cases are a Summary of the Weekly Returns of Notifiable Diseases received Quarterly Returns of

In Registration Divisions.	Urban Sanitary Districts.	Population (1891).	SMALL-POX									
			1st Quarter		2nd Quarter		3rd Quarter		4th Quarter		Total for 1893	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
I.	[illegible]	1,292,118	541	78	1,487	199	664	49	331	37	3023	363
II. South Eastern.	Croydon	102,695	3	1	17	—	6	—	1	—	27	1
	[illegible]	33,300	2	—	—	—	—	—	—	—	2	—
	[illegible]	34,969	—	—	—	—	—	—	—	—	—	—
	[illegible]	37,781	—	—	1	—	3	1	—	—	4	1
	[illegible]	65,325	83	6	37	3	6	—	—	—	127	9
	[illegible]	60,054	2	—	22	—	1	—	—	—	25	—
III. South Midland.	Wimbledon	61,265	2	1	7	—	—	—	14	—	23	1
	Hornsey	44,205	2	—	4	—	1	—	4	—	11	—
	Tottenham	71,343	3	—	17	—	42	2	1	—	63	2
	Oxford	46,742	2	—	2	—	—	—	—	—	4	—
	Northampton	61,012	21	—	15	—	—	—	—	—	36	—
	Cambridge	36,983	1	—	4	—	—	—	—	—	5	—
	Leyton	63,056	3	—	5	—	—	—	2	1	10	1
IV. Eastern.	Walthamstow	46,846	—	—	7	—	—	—	—	—	7	—
	West Ham	204,366	26	3	173	15	105	17	28	1	332	36
	Colchester	34,859	—	—	—	—	—	—	—	—	—	—
	Norwich	100,079	1	—	—	—	—	—	—	—	1	—
V. South Western.	Exeter	37,404	4	—	2	—	—	—	—	—	6	—
	Plymouth	81,468	—	—	1	—	—	—	—	—	1	—
	Devonport	54,899	1	—	4	—	—	—	—	—	5	—
	Bath	51,954	—	—	—	—	—	—	11	3	11	3
VI. West Midland.	Bristol	328,978	11	1	18	1	5	—	133	15	167	17
	St. George	36,758	—	—	6	1	34	3	33	2	73	6
	Gloucester	39,444	1	—	2	—	—	—	—	—	3	—
	Burton-on-Trent	46,867	7	—	7	1	2	—	—	—	16	1
	Wolverhampton	82,492	2	—	6	—	—	—	3	1	8	1
	Walsall	71,789	1	—	14	—	174	13	379	54	568	67
	West Bromwich	59,474	1	—	8	—	—	—	22	6	31	6
	Worcester	47,965	3	—	1	—	—	—	5	1	13	1
	Smethwick	68,139	1	—	10	—	1	—	9	—	21	—
	Birmingham	478,113	45	—	246	19	118	9	502	45	911	73
	Aston Manor	68,639	3	—	21	1	5	—	97	—	126	1
	Coventry	52,524	9	—	19	—	—	—	—	—	28	—
VII. North Midland.	Leicester	174,624	192	4	117	5	45	2	21	1	375	12
	[illegible]	52,405	2	1	—	—	—	—	—	—	2	1
	[illegible]	21,527	10	2	17	1	—	—	7	—	34	4
	Derby	38,043	28	4	11	2	4	—	7	—	50	7

No. 12.

Compilation of Returns of Notified Infectious Diseases, and registered Deaths thereto

81 Urban Sanitary Districts, the Number of Notified Cases and of with an Annual Summary of these data for each of the Urban

by the Board from Medical Officers of Health. The Deaths are extracted from the the Registrar-General.]

In Registration Divisions.	Urban Sanitary Districts.	Population (1891).	Small-Pox—*continued.*									
			1st Quarter.		2nd Quarter.		3rd Quarter.		4th Quarter.		Total for 1893.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
VIII. North-Western.	Stockport	70,263	23	2	5	—	1	—	—	—	29	2
	Macclesfield	36,000	6	—	—	—	—	—	—	—	6	—
	Birkenhead	99,857	5	—	6	1	2	—	2	—	15	1
	Wallasey	33,229	—	—	1	—	—	—	—	—	1	—
	Liverpool	517,980	40	6	27	1	1	—	7	2	75	9
	St. Helens (Lancs.)	71,288	33	5	4	—	1	—	—	—	38	5
	Southport	41,406	—	—	4	—	2	—	4	—	10	—
	Wigan	55,013	6	—	7	—	—	—	—	—	13	—
	Warrington	52,743	112	11	71	5	3	1	—	—	186	17
	Bolton	115,002	16	4	16	1	—	1	9	1	41	7
	Bury (Lancs)	57,212	5	—	6	—	—	—	—	—	11	—
	Salford	198,139	83	7	63	11	31	4	—	—	177	22
	Manchester	505,368	393	28	217	17	15	3	4	—	629	48
	Ashton-under-Lyne	40,463	1	—	7	—	11	—	1	—	20	—
	Oldham	131,463	163	21	161	30	52	8	39	6	415	65
	Accrington	38,603	1	—	3	—	1	—	—	—	5	—
	Burnley	87,016	23	2	43	4	—	—	—	—	66	6
	Blackburn	120,064	36	—	29	2	8	2	—	—	73	4
	Darwen	34,192	2	—	3	—	—	—	—	—	5	—
	Preston	107,573	2	—	1	—	—	—	—	—	3	—
	Barrow-in-Furness	51,712	1	—	6	1	—	—	—	—	7	1
IX. Yorkshire.	Huddersfield	95,420	22	—	16	—	8	—	1	—	47	—
	Halifax	89,832	95	13	222	22	13	—	3	—	333	35
	Bradford	216,361	33	3	229	19	286	31	452	62	1,000	115
	Wakefield	33,146	100	9	79	2	50	7	60	7	289	25
	Barnsley	35,427	24	4	2	2	—	—	—	—	26	6
	Sheffield	324,243	39	1	54	4	9	—	—	—	102	5
	Rotherham	42,061	40	2	10	—	—	—	1	—	51	2
	York	67,004	34	4	30	2	3	—	—	—	67	6
	Hull	200,044	56	2	101	6	20	—	1	—	178	8
	Middlesbrough	75,532	22	2	38	4	12	1	14	—	86	7
X. Northern.	Darlington	38,060	1	—	1	—	—	—	—	—	2	—
	Hartlepool	21,271	3	—	—	—	—	—	—	—	3	—
	West Hartlepool	42,710	8	—	—	—	—	—	—	—	8	—
	Sunderland	131,015	14	3	18	1	2	1	2	—	36	5
	South Shields	78,391	7	2	37	3	1	—	—	—	45	5
	Newcastle-on-Tyne	186,300	6	—	10	—	8	—	—	—	24	—
	Tynemouth	46,588	4	—	1	—	21	2	1	—	27	2
	Carlisle	39,176	8	1	3	—	—	—	—	—	11	1
XI. Welsh.	Newport (Mon.)	54,707	4	—	1	—	—	—	—	—	5	—
	Cardiff	128,915	4	—	—	—	—	—	—	—	4	—
	Merthyr Tydfil	58,080	1	—	—	—	—	—	—	—	1	—
	Swansea	90,349	17	—	4	—	1	—	1	—	23	—
	Totals, 81 Districts	11,894,990	2,434	193	3,846	285	1,606	167	2,552	241	10,438	886

App. A. No. 12.

Comparison of Returns of Notified Infectious Diseases with registered Deaths therefrom.

In Registration Divisions.	Urban Sanitary Districts.	Population (1891).	Scarlet Fever. 1st Quarter. Cases.	1st Quarter. Deaths.	2nd Quarter. Cases.	2nd Quarter. Deaths.	3rd Quarter. Cases.	3rd Quarter. Deaths.	4th Quarter. Cases.	4th Quarter. Deaths.	Total for 1893. Cases.	Total for 1893. Deaths.
I.	London (*Admin. Co.*)	4,232,118	4,943	335	7,779	396	12,718	458	11,409	367	36,849	1,556
II. South-Eastern.	Croydon	102,895	79	4	163	3	143	—	234	4	619	11
	Dover	33,300	14	1	14	—	7	—	11	—	46	1
	Eastbourne	34,989	11	1	60	2	99	3	49	1	219	7
	Bournemouth	57,781	37	2	60	4	137	4	68	3	311	13
	Southampton	69,325	12	—	35	1	31	1	18	2	96	4
	Reading	60,054	31	—	39	—	70	—	75	1	215	1
III. South Midland.	Willesden	61,565	130	6	170	5	134	5	158	—	592	16
	Hornsey	44,205	47	3	100	2	90	2	129	7	366	14
	Tottenham	71,343	134	6	193	2	158	18	176	5	661	31
	Oxford	45,742	32	2	57	1	67	2	102	2	258	7
	Northampton	64,012	59	—	54	1	46	2	50	3	209	6
	Cambridge	36,983	25	—	37	—	44	—	42	2	148	2
	Leyton	63,656	107	2	117	15	149	6	166	4	539	27
IV. Eastern.	Walthamstow	46,345	77	4	157	7	177	5	188	4	599	20
	West Ham	204,903	472	24	514	17	645	25	553	14	2,184	80
	Colchester	34,559	78	4	45	2	39	—	52	3	214	9
	Norwich	100,970	103	1	103	5	211	7	246	7	663	20
V. South-Western.	Exeter	37,494	117	1	133	1	185	2	326	5	761	9
	Plymouth	84,248	158	11	69	2	84	2	186	7	497	22
	Devonport	54,893	80	7	46	2	36	1	69	2	231	12
	Bath	51,844	62	2	120	6	72	2	52	—	306	10
VI. West Midland.	Bristol	221,578	244	9	245	7	342	8	434	11	1,265	35
	St. George	36,718	59	5	33	2	38	2	62	4	192	13
	Gloucester	39,444	67	—	71	1	71	1	76	3	285	5
	Burton-on-Trent	46,647	68	3	64	—	60	—	184	2	376	5
	Wolverhampton	82,932	63	1	98	2	151	6	294	17	606	26
	Walsall	71,789	139	4	114	4	75	4	98	4	426	16
	West Bromwich	59,474	50	7	69	4	71	2	73	2	263	15
	Worcester	42,005	35	—	74	3	94	3	73	—	276	10
	Smethwick	36,170	111	—	49	—	32	1	64	2	256	3
	Birmingham	478,113	278	9	451	22	435	20	452	17	1,616	68
	Aston Manor	68,639	44	3	61	3	63	—	49	—	217	5
	Coventry	52,724	8	—	11	—	6	—	9	—	34	—
VII. North Midland.	Leicester	174,624	424	8	657	21	775	27	483	24	2,339	80
	Grimsby	51,934	25	—	66	3	25	1	89	2	205	6
	Nottingham	213,877	226	14	254	11	431	18	557	38	1,468	81
	Derby	94,146	95	2	99	4	194	6	112	2	500	14

App. A. No. 12.

Compilation of Returns of Notified Infectious Diseases, and registered Deaths therefrom.

SCARLET FEVER—*continued.*

In Registration Divisions.	Urban Sanitary Districts.	Population (1891).	1st Quarter.		2nd Quarter.		3rd Quarter.		4th Quarter.		Total for 1893.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
VIII. North-Western.	Stockport	70,263	43	—	53	2	85	7	74	5	255	14
	Macclesfield	36,000	56	3	55	2	85	4	55	3	251	12
	Birkenhead	99,857	78	2	134	5	62	3	143	2	417	12
	Wallasey	33,229	21	—	15	2	19	—	65	—	120	2
	Liverpool	517,980	507	48	728	48	875	43	1,445	92	3,555	231
	St. Helens (Lancs.)	71,288	88	1	33	2	29	2	89	2	239	7
	Southport	41,406	24	1	50	2	33	1	104	5	211	9
	Wigan	55,013	55	5	100	15	108	17	71	8	334	45
	Warrington	52,743	78	4	77	10	98	15	106	13	359	42
	Bolton	115,002	202	11	253	10	176	10	96	3	727	34
	Bury (Lancs.)	57,212	92	2	109	3	73	4	86	4	360	13
	Salford	198,139	232	16	173	3	240	15	219	7	864	41
	Manchester	505,368	383	47	448	35	549	24	654	32	2,034	138
	Ashton-under-Lyne	40,463	14	1	33	4	54	1	67	3	168	9
	Oldham	131,463	172	5	105	7	85	1	80	3	442	16
	Accrington	38,603	5	—	4	1	11	—	14	—	34	1
	Burnley	87,016	107	3	257	13	376	16	348	19	1,088	51
	Blackburn	120,064	54	1	73	3	38	1	29	—	194	5
	Darwen	34,192	35	1	69	3	33	1	99	4	236	9
	Preston	107,573	135	11	103	7	79	2	112	7	429	27
	Barrow-in-Furness	51,712	100	3	260	3	111	5	116	3	587	14
IX. Yorkshire.	Huddersfield	95,420	84	4	191	6	130	6	182	9	587	25
	Halifax	89,832	50	—	52	1	40	1	17	1	159	3
	Bradford	216,361	247	19	218	10	683	29	297	12	1,445	70
	Wakefield	33,146	33	—	21	1	18	1	8	—	80	2
	Barnsley	35,427	83	6	122	12	52	5	24	6	281	29
	Sheffield	324,243	445	19	643	25	414	28	316	18	1,818	90
	Rotherham	42,061	15	1	18	2	17	—	21	2	71	5
	York	67,004	24	—	55	—	39	1	42	1	160	2
	Hull	200,044	159	6	188	9	164	6	255	12	766	33
	Middlesbrough	75,532	23	—	106	1	128	5	164	—	421	6
X. Northern.	Darlington	38,060	45	1	28	—	6	1	13	—	92	2
	Hartlepool	21,271	7	2	10	4	7	1	5	—	29	7
	West Hartlepool	42,710	35		33		21		45	—	134	
	Sunderland	131,015	188	5	163	6	227	5	381	10	959	26
	South Shields	78,391	109	10	108	8	165	7	218	20	600	45
	Newcastle-on-Tyne	186,300	212	6	124	4	127	5	223	8	686	23
	Tynemouth	46,588	70	3	55	1	35	—	57	3	217	7
	Carlisle	39,176	20	1	13	—	52	3	99	9	184	13
XI. Welsh.	Newport (Mon.)	54,707	259	13	182	2	149	1	99	3	689	19
	Cardiff	128,915	191	8	237	16	197	4	192	11	817	39
	Merthyr Tydfil	58,080	126	4	211	7	120	4	122	2	579	17
	Swansea	90,349	320	14	229	8	183	3	340	8	1,072	33
	Totals, 81 Districts	11,894,990	13,961	768	18,629	808	24,398	931	24,630	1,021	81,618	3,528

Appx. A. No. 12.

Compilation of Returns of Notified Infectious Diseases and registered Deaths there from.

In Registration Divisions	Urban Sanitary Districts.	Population (1891).	Diphtheria. 1st Quarter. Cases.	1st Quarter. Deaths.	2nd Quarter. Cases.	2nd Quarter. Deaths.	3rd Quarter. Cases.	3rd Quarter. Deaths.	4th Quarter. Cases.	4th Quarter. Deaths.	Totals for 1893. Cases.	Totals for 1893. Deaths.
I.	London - - (Admin. Co.)	4,232,118	1,971	639	2,843	677	3,917	859	4,245	1,089	12,976	3,265
II. South Eastern.	Croydon	102,695	30	14	71	23	89	21	111	22	301	80
	Dover	34,899	2	1	1	—	1	1	1	1	5	3
	Eastbourne	34,969	9	2	16	1	13	3	13	1	51	7
	Hastings	37,781	4	1	2	1	1	2	3	—	10	4
	Southampton	65,325	7	—	7	—	17	3	19	—	50	3
	Reading	60,054	2	2	3	3	7	2	6	1	18	8
III. South Midland.	Willesden	61,265	46	10	70	5	56	13	43	9	215	37
	Hornsey	44,205	13	5	21	5	40	7	64	10	138	27
	Tottenham	71,343	28	6	36	13	40	12	52	31	156	64
	Oxford	45,742	30	11	28	7	21	4	22	11	101	33
	Northampton	61,912	4	2	1	2	2	-	2	1	9	5
	Cambridge	36,983	5	—	1	1	2	—	8	3	16	4
	Leyton	63,056	46	8	71	13	65	7	57	12	239	40
IV. Eastern.	Walthamstow	46,346	34	8	49	11	21	3	31	10	135	32
	West Ham	204,903	93	22	112	21	115	28	153	24	473	95
	Colchester	34,559	8	1	21	—	6	2	6	2	41	5
	Norwich	100,970	33	7	28	3	24	2	51	11	136	23
V. South Western.	Exeter	37,404	1	—	1	—	5	1	9	1	16	2
	Plymouth	84,248	16	4	17	4	15	3	17	3	65	14
	Devonport	54,805	7	1	6	—	9	—	15	4	37	5
	Bath	51,844	6	2	11	5	15	1	16	3	48	11
VI. West Midland.	Bristol	221,178	24	8	29	11	24	11	37	19	114	49
	St. George	36,748	6	1	8	1	1	—	5	2	20	4
	Gloucester	39,494	22	1	10	3	11	3	12	3	55	10
	Birkenhead Town	46,847	16	3	25	2	7	3	7	2	55	10
	Wolverhampton	82,092	8	—	5	1	12	2	13	2	38	5
	Walsall	71,789	2	—	6	1	2	—	6	1	16	2
	West Bromwich	59,474	2	—	11	3	4	—	4	1	21	4
	Worcester	42,208	6	1	11	4	10	1	13	4	40	10
	Smethwick	36,176	1	—	4	1	2	—	4	—	11	1
	Birmingham	478,113	61	15	77	13	110	15	85	20	333	63
	Aston Manor	68,639	15	1	17	1	10	1	6	—	48	3
	Coventry	52,724	5	—	—	1	3	-	1	—	9	1
VII. North Midland.	Leicester	174,624	27	3	49	7	41	4	23	7	140	20
	Grimsby	51,464	25	5	20	4	16	1	56	19	117	29
	Nottingham	213,877	20	4	19	2	16	3	24	6	79	15
	Derby	94,146	8	4	14	—	19	2	17	1	49	7

DIPHTHERIA—*continued.*

In Registration Divisions.	Urban Sanitary Districts.	Population (1891).	1st Quarter.		2nd Quarter.		3rd Quarter.		4th Quarter.		Total for 1893.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
VIII. North-Western.	Stockport	70,263	22	8	13	5	23	12	5	8	63	33
	Macclesfield	36,000	—	1	1	2	2	2	2	1	5	6
	Birkenhead	99,857	8	4	21	7	13	1	32	4	74	16
	Wallasey	33,229	7	—	18	8	3	—	10	1	38	9
	Liverpool	517,980	59	14	54	8	48	17	76	24	237	63
	St. Helens (Lancs.)	71,288	19	1	7	1	18	5	27	3	71	10
	Southport	41,406	10	3	9	—	12	2	5	2	36	7
	Wigan	55,013	3	1	5	—	3	3	5	—	16	4
	Warrington	52,743	10	6	1	2	3	—	2	4	16	12
	Bolton	115,002	38	4	39	4	29	4	6	—	112	12
	Bury (Lancs.)	57,212	8	6	7	4	7	1	12	4	34	15
	Salford	168,139	63	20	48	12	45	9	45	17	201	58
	Manchester	505,368	103	45	161	47	141	40	138	33	543	165
	Ashton-under-Lyne	40,463	4	2	3	—	5	—	4	3	16	5
	Oldham	131,463	6	4	4	5	8	5	7	4	25	18
	Accrington	38,603	5	5	6	—	3	—	13	1	27	6
	Burnley	87,016	7	4	10	3	7	3	2	4	26	14
	Blackburn	120,064	2	—	1	—	—	—	1	2	4	2
	Darwen	34,192	1	3	3	3	—	—	1	—	5	6
	Preston	107,573	14	7	6	—	6	3	5	4	31	14
	Barrow-in-Furness	51,712	3	—	14	4	12	7	13	2	42	13
IX. Yorkshire.	Huddersfield	95,420	7	2	1	1	5	—	2	—	15	3
	Halifax	89,832	13	7	20	10	7	2	13	4	53	23
	Bradford	216,361	13	4	14	6	22	5	26	8	75	23
	Wakefield	33,146	10	2	4	—	5	4	3	3	22	9
	Barnsley	35,427	18	3	25	1	16	1	18	—	77	5
	Sheffield	324,243	44	12	34	17	24	8	30	24	132	61
	Rotherham	42,061	—	2	—	—	4	2	5	—	9	4
	York	67,004	7	1	5	—	3	1	13	5	28	7
	Hull	200,044	21	5	22	6	27	2	33	9	103	22
	Middlesbrough	75,532	8	4	6	2	6	4	12	1	32	11
X. Northern.	Darlington	38,060	5	1	1	—	1	1	1	—	8	2
	Hartlepool	21,271	—	} 1	1	} 3	5	} —	6	} 2	12	} 6
	West Hartlepool	42,710	1		5		1		3		10	
	Sunderland	131,015	9	3	4	1	2	5	6	2	21	11
	South Shields	78,391	13	7	12	5	15	2	15	2	55	16
	Newcastle-on-Tyne	186,300	46	6	27	3	35	9	56	13	164	31
	Tynemouth	46,588	10	1	4	—	2	—	9	—	25	1
	Carlisle	39,176	24	8	18	2	15	3	14	3	71	16
XI. Welsh.	Newport (Mon.)	54,707	17	6	12	1	13	5	7	4	49	16
	Cardiff	128,915	136	39	135	28	91	17	91	14	453	98
	Merthyr Tydfil	58,080	40	4	54	4	20	2	24	8	138	18
	Swansea	90,349	7	1	6	2	4	2	4	—	21	5
	Totals, 81 Districts	11,894,990	3,493	1,048	4,562	1,061	5,471	1,210	6,059	1,559	19,585	4,878

In Registration Divisions.	Urban Sanitary Districts.	Population (1891).	"Fever." 1st Quarter. Notifications. Typhus.	Enteric.	Continued.	Total.	Deaths.	2nd Quarter. Notifications. Typhus.	Enteric.	Continued.	Total.	Deaths.
I.	London (*Administrative Co.*)	4,232,118	5	541	37	583	105		735	43	786	122
II. South-Eastern.	Croydon	102,695	—	6	—	6	—	—	8	2	10	2
	Dover	33,300	—	2	—	2	—	—	1	—	1	1
	Eastbourne	34,969	—	6	—	6	1	—	—	—	—	—
	Bournemouth	37,781	—	2	—	2	—	—	6	—	6	2
	Southampton	65,325	—	10	—	10	1	—	28	—	28	5
	Reading	60,054	14	3	—	17	6	—	3	—	3	2
III. South Midland.	Willesden	61,265	1	4	—	5	1	—	8	—	8	1
	Hornsey	44,205	—	4	—	4	—	—	5	—	5	2
	Tottenham	71,343	—	19	1	20	4	—	16	—	16	3
	Oxford	45,742	—	3	—	3	—	—	3	—	3	1
	Northampton	61,012	—	4	—	4	1	—	5	—	5	—
	Cambridge	36,983	—	8	—	8	2	1	8	—	9	2
	Leyton	63,056	—	6	2	8	1	—	22	2	24	4
IV. Eastern.	Walthamstow	46,346	—	4	—	4	—	—	13	—	13	1
	West Ham	204,903	—	30	—	30	8	1	49	5	55	10
	Colchester	34,559	—	4	6	10	—	—	5	5	10	1
	Norwich	100,970	—	21	—	21	4	—	40	—	40	3
V. South-Western.	Exeter	37,404	—	20	1	21	4	—	8	—	8	1
	Plymouth	84,248	—	7	—	7	4	—	11	—	11	2
	Devonport	54,803	—	6	—	6	—	—	12	—	12	2
	Bath	51,844	—	1	—	1	2	—	9	—	9	—
VI. West Midland.	Bristol	221,578	—	31	—	31	11	—	33	2	35	7
	St. George	36,718	1	14	2	17	2	—	7	—	7	2
	Gloucester	39,444	—	5	—	5	—	—	5	—	5	1
	Burton-on-Trent	46,047	—	9	—	9	2	—	5	—	5	1
	Wolverhampton	82,662	—	27	—	27	4	—	21	1	22	4
	Walsall	71,789	—	18	—	18	4	—	7	—	7	3
	West Bromwich	59,474	—	13	—	13	—	—	13	—	13	4
	Worcester	42,908	—	24	—	24	1	—	5	—	5	2
	Smethwick	36,170	—	3	—	3	—	—	1	—	1	—
	Birmingham	478,113	—	100	—	100	20	—	88	11	99	13
	Aston Manor	68,639	—	18	—	18	1	—	18	1	19	5
	Coventry	52,724	—	15	2	17	2	—	8	—	8	2
VII. North Midland.	Leicester	174,624	—	26	—	26	3	—	44	—	44	5
	Grimsby	51,934	—	13	9	22	4	—	19	7	26	3
	Nottingham	213,877	—	86	—	86	12	—	53	—	53	13
	Derby	94,146	—	13	—	13	3	—	11	—	11	2

"Fever."																
3rd Quarter.					4th Quarter.					Totals for 1893.					Urban Sanitary Districts.
Notifications.				Deaths.	Notifications.				Deaths.	Notifications.				Deaths.	
Typhus.	Enteric.	Continued.	Total.		Typhus.	Enteric.	Continued.	Total.		Typhus.	Enteric.	Continued.	Grand Total.		
8	1,037	52	1,097	219	4	1,350	73	1,427	273	25	3,663	205	3,893	719	London. (*Admin. Co.*)
—	15	—	15	4	—	8	—	8	6	—	37	2	39	12	Croydon.
—	3	—	3	2	—	7	—	7	—	—	13	—	13	3	Dover.
—	8	—	8	1	—	2	—	2	1	—	16	—	16	3	Eastbourne.
—	—	1	1	—	—	4	—	4	—	—	12	1	13	2	Bournemouth.
—	28	—	28	5	—	41	—	41	9	—	107	—	107	20	Southampton.
—	7	—	7	3	—	8	—	8	3	14	21	—	35	14	Reading.
—	19	—	19	2	—	16	—	16	4	1	47	—	48	8	Willesden.
—	12	—	12	2	—	4	1	5	3	—	25	1	26	7	Hornsey.
—	38	—	38	8	—	70	—	70	9	—	143	1	144	24	Tottenham.
—	10	—	10	1	1	2	—	3	—	1	18	—	19	2	Oxford.
—	12	—	12	2	—	14	—	14	3	—	35	—	35	6	Northampton.
—	19	1	20	6	—	10	—	10	2	1	45	1	47	12	Cambridge.
—	44	2	46	10	—	32	—	32	2	—	104	6	110	17	Leyton.
—	16	1	17	3	—	23	—	23	6	—	56	1	57	10	Walthamstow.
—	126	2	128	24	—	154	4	158	26	1	359	11	371	68	West Ham.
—	6	5	11	2	—	3	6	9	1	—	18	22	40	4	Colchester.
—	149	2	151	15	—	104	—	104	15	—	314	2	316	37	Norwich.
1	10	—	11	—	—	20	2	22	5	1	58	3	62	10	Exeter.
—	11	—	11	3	—	27	—	27	1	—	56	—	56	10	Plymouth.
—	18	—	18	1	—	13	—	13	4	—	49	—	49	7	Devonport.
—	2	—	2	—	—	1	—	1	1	—	13	—	13	3	Bath.
—	39	4	43	5	—	18	—	18	2	—	121	6	127	25	Bristol.
—	10	—	10	1	—	3	—	3	—	1	34	2	37	5	St. George.
—	12	—	12	1	—	10	—	10	1	—	32	—	32	3	Gloucester.
—	12	—	12	3	—	10	—	10	3	—	36	—	36	9	Burton-on-Trent.
—	64	—	64	11	—	43	4	47	9	—	155	5	160	28	Wolverhampton.
—	54	—	54	8	—	31	—	31	9	—	110	—	110	24	Walsall.
—	39	1	40	6	—	27	1	28	8	—	92	2	94	18	West Bromwich.
—	15	—	15	1	—	21	—	21	5	—	65	—	65	9	Worcester.
—	30	—	30	5	—	12	—	12	4	—	46	—	41	9	Smethwick.
—	158	6	164	36	4	153	4	161	29	4	499	21	524	98	Birmingham.
—	67	5	72	9	—	18	—	18	3	—	121	6	127	18	Aston Manor.
—	10	—	10	4	—	5	1	6	2	—	38	3	41	10	Coventry.
—	197	—	197	24	—	120	—	120	14	—	387	—	387	46	Leicester.
—	194	4	198	23	—	87	19	106	31	—	313	39	352	61	Grimsby.
—	172	—	172	19	—	170	—	170	25	—	481	—	481	69	Nottingham.
—	36	—	36	6	—	48	—	48	11	—	109	—	108	22	Derby.

In Registration Divisions.	Urban Sanitary Districts.	Population (1891).	"Fever."									
			1st Quarter.					2nd Quarter.				
			Notifications.				Deaths.	Notifications.				Deaths.
			Typhus.	Enteric.	Continued.	Total.		Typhus.	Enteric.	Continued.	Total.	
VIII. North-Western.	Stockport	70,263	—	10	—	10	2	—	16	3	19	1
	Macclesfield	36,000	—	1	—	1	—	—	3	1	4	1
	Birkenhead	99,857	—	31	4	35	5	3	34	—	37	4
	Wallasey	33,229	—	11	—	11	2	—	22	—	22	3
	Liverpool	517,980	40	183	26	249	36	44	208	15	267	43
	St. Helens (Lancs.)	71,288	—	38	—	38	11	—	15	—	15	1
	Southport	41,406	—	7	—	7	—	—	7	—	7	—
	Wigan	55,013	1	11	7	19	—	—	12	9	21	—
	Warrington	52,743	—	3	—	3	2	—	—	—	—	—
	Bolton	115,002	1	47	—	48	14	—	17	1	18	5
	Bury (Lancs.)	57,212	—	9	2	11	3	—	10	—	10	1
	Salford	198,139	—	73	2	75	14	1	61	2	64	12
	Manchester	505,368	1	115	—	116	26	—	76	—	76	30
	Ashton-under-Lyne	40,463	—	14	1	15	4	—	9	2	11	1
	Oldham	131,463	—	28	—	28	10	—	9	—	9	2
	Accrington	38,603	—	1	1	2	—	—	8	—	8	—
	Burnley	87,016	—	32	—	32	4	3	34	2	39	6
	Blackburn	120,064	—	32	—	32	8	1	38	—	39	7
	Darwen	34,192	—	9	—	9	2	—	8	—	8	3
	Preston	107,573	—	24	—	24	6	—	16	—	16	3
	Barrow-in-Furness	51,712	—	11	9	20	—	2	12	8	22	1
IX. Yorkshire.	Huddersfield	95,420	—	12	—	12	1	—	3	—	3	—
	Halifax	89,832	—	20	1	21	6	—	6	—	6	1
	Bradford	216,361	—	17	—	17	3	—	14	1	15	8
	Wakefield	33,146	—	16	—	16	5	—	3	—	3	—
	Barnsley	35,427	—	13	—	13	3	—	19	—	19	2
	Sheffield	324,243	—	43	6	49	13	—	40	7	47	11
	Rotherham	42,061	—	10	—	10	2	2	9	—	11	2
	York	67,004	—	15	—	15	2	—	14	1	15	3
	Hull	200,044	—	36	1	37	4	—	30	4	34	5
	Middlesbrough	75,532	—	29	—	29	7	—	23	1	24	8
X. Northern.	Darlington	38,060	—	4	1	5	—	—	4	1	5	2
	Hartlepool	21,271	—	2	—	2	2	—	1	—	1	2
	West Hartlepool	42,710	—	3	—	3		—	6	—	6	
	Sunderland	131,015	12	32	16	60	16	3	56	24	83	10
	South Shields	78,391	—	18	—	18	11	—	12	1	13	10
	Newcastle-on-Tyne	186,300	—	9	1	10	3	3	13	—	16	4
	Tynemouth	46,588	—	6	1	7	1	—	7	—	7	2
	Carlisle	39,176	—	4	1	5	1	1	6	—	7	3
XI. Welsh.	Newport (Mon.)	54,707	4	19	1	24	3	—	21	—	21	5
	Cardiff	128,915	33	26	1	60	12	3	17	1	21	4
	Merthyr Tydfil	58,080	—	13	—	13	1	—	10	—	10	1
	Swansea	90,349	—	20	—	20	—	—	28	—	28	3
	Totals, 81 Districts	11,894,990	113	2,183	142	2,438	458	76	2,290	163	2,529	446

"Fever."															Urban Sanitary Districts
3rd Quarter.					4th Quarter.					Totals for 1893.					
Notifications.				Deaths.	Notifications.				Deaths.	Notifications.				Deaths.	
Typhus.	Enteric.	Continued.	Total.		Typhus.	Enteric.	Continued.	Total.		Typhus.	Enteric.	Continued.	Grand Total.		
—	154	9	163	32	—	60	—	60	17	—	240	12	252	52	Stockport.
—	6	1	7	1	—	3	1	4	1	—	13	3	16	3	Macclesfield.
1	75	—	76	10	1	80	3	84	8	5	220	7	232	27	Birkenhead.
—	50	—	50	6	—	50	—	50	10	—	133	—	133	23	Wallasey.
41	499	42	582	92	57	508	30	595	98	182	1,398	113	1,693	269	Liverpool.
—	141	2	143	17	—	121	1	122	21	—	315	3	318	50	St. Helens (Lancs.).
—	19	—	19	10	—	16	1	17	5	—	49	1	50	15	Southport.
—	103	23	126	7	18	134	33	185	29	19	260	72	351	36	Wigan.
—	17	—	17	8	—	22	—	22	6	—	42	—	42	16	Warrington.
—	55	—	55	12	—	41	—	41	5	1	160	1	162	36	Bolton.
—	27	3	30	4	—	29	3	32	3	—	75	8	83	11	Bury (Lancs.).
—	243	8	251	34	—	179	3	182	40	1	556	15	572	100	Salford.
1	205	—	206	28	—	220	—	220	45	2	616	—	618	129	Manchester.
—	21	2	23	5	—	12	2	14	2	—	56	7	63	12	Ashton-under-Lyne.
—	20	—	20	4	—	13	—	13	10	—	70	—	70	26	Oldham.
—	17	—	17	2	—	26	—	26	4	—	52	1	53	6	Accrington.
1	36	—	37	12	2	27	—	29	6	6	129	2	137	28	Burnley.
—	46	—	46	8	—	41	—	41	7	1	157	—	158	30	Blackburn.
—	9	—	9	—	—	4	—	4	2	—	30	—	30	7	Darwen.
—	99	—	99	27	—	56	—	56	15	—	195	—	195	51	Preston.
—	29	8	37	3	—	20	9	29	9	2	72	34	108	13	Barrow-in-Furness.
—	21	—	21	4	—	21	—	21	7	—	57	—	57	12	Huddersfield.
—	15	2	17	4	—	28	1	29	2	—	69	4	73	13	Halifax.
—	81	1	82	14	—	101	3	104	24	—	213	5	218	49	Bradford.
—	7	—	7	2	—	33	—	33	6	—	59	—	59	13	Wakefield.
—	73	6	79	19	—	116	8	124	22	—	221	14	235	46	Barnsley.
—	174	7	181	28	—	195	15	210	38	—	452	35	487	90	Sheffield.
—	22	—	22	12	1	24	—	25	7	3	65	—	68	23	Rotherham.
—	162	—	162	19	—	96	—	96	16	—	287	1	288	40	York.
—	318	17	335	39	—	270	18	288	51	—	654	40	694	99	Hull.
—	64	2	66	15	—	125	2	127	22	—	241	5	246	52	Middlesbrough.
—	74	8	82	7	—	58	1	59	8	—	140	11	151	17	Darlington.
—	5	1	6	4	—	7	3	10	7	—	15	4	19	15	Hartlepool.
—	17	—	17		—	23	—	23		—	49	—	49		West Hartlepool.
13	381	44	438	46	7	339	33	379	59	35	808	117	960	131	Sunderland.
—	90	4	94	21	—	52	3	55	35	—	172	8	180	77	South Shields.
—	53	5	58	7	1	65	3	69	11	4	140	9	153	25	Newcastle-on-Tyne.
—	26	—	26	3	—	29	—	29	12	—	68	1	69	18	Tynemouth.
—	4	—	4	2	—	6	—	6	—	1	20	1	22	6	Carlisle.
—	70	1	71	7	—	22	5	27	1	4	132	7	143	16	Newport (Mon.).
—	37	1	38	5	1	23	—	24	6	37	103	3	143	27	Cardiff.
—	33	—	33	9	—	37	2	39	3	—	93	2	95	14	Merthyr Tydfil.
—	25	—	25	4	—	37	—	37	12	—	110	—	110	19	Swansea.
66	6,322	283	6,671	1,068	97	6,058	298	6,453	1,222	352	16,853	886	18,091	3,194	Totals, 81 Districts.

No. 12A.

Table showing, Week by Week, during the Year 1893, for each of the Sanitary Areas within the Cases and of Registered Deaths from the following Diseases, together with

The Cases are copied from the Weekly Returns of Notifiable Diseases received by the Board from the Metropolitan

	Sanitary Areas.	Population (1891).	Small-pox. Weekly Statement, 1st Quarter, 1893											
			Jan. 7.		Jan. 14.		Jan. 21.		Jan. 28.		Feb. 4.		Feb. 11.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
	London	4,232,118	23	—	22	1	23	1	28	—	31	5	27	—
	(Administrative County)		23	—	21	—	19	—	28	—	31	—	27	—
W. District.	Kensington	166,308	—	—	—	—	—	—	—	—	—	1	—	—
	Fulham	91,639	—	—	—	—	—	—	—	—	—	—	—	—
	Hammersmith	97,239	—	—	—	—	—	—	—	—	—	—	—	—
	Paddington	117,846	—	—	—	—	—	—	—	—	—	—	—	—
	Chelsea	98,253	—	—	2	—	1	—	3	—	—	—	—	—
	St. George Hanover Sq.*	78,509	—	—	—	—	—	—	2	—	—	—	—	—
	Westminster	55,359	1	—	2	—	1	—	—	—	—	—	1	—
	St. James, Westminster	24,935	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	St. Marylebone	142,604	1	—	—	—	1	—	2	—	6	—	1	—
	Hampstead	68,416	—	—	—	—	—	—	—	—	—	—	—	—
	St. Pancras	234,879	2	—	1	—	3	—	2	—	—	1	—	—
	Islington	319,149	2	—	2	—	3	—	3	—	4	—	3	—
	Hackney	229,542	—	—	—	—	3	—	1	—	5	1	1	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	—	—	—	—	—	—	2	—	1	—	2	—
	St. Martin-in-the-Fields	14,616	—	—	—	—	—	—	—	—	—	—	—	—
	Strand†	25,237	—	—	—	—	—	—	—	—	—	—	—	—
	Holborn‡	34,093	—	—	—	—	—	—	—	—	—	—	—	—
	Clerkenwell	66,216	—	—	—	—	—	—	—	—	—	—	—	—
	St. Luke, Middlesex	42,440	—	—	—	—	—	—	—	—	—	—	1	—
	London, City of	37,583	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Shoreditch	124,089	—	—	—	—	1	—	1	—	—	—	—	—
	Bethnal Green	129,142	—	—	—	—	1	—	—	—	—	—	—	—
	Whitechapel	74,420	—	—	3	—	1	—	4	—	—	1	—	—
	St. George-in-the-East	45,795	—	—	1	—	1	—	3	—	1	—	—	—
	Limehouse	57,876	—	—	—	—	—	—	—	—	2	—	1	—
	Mile End Old Town	107,592	—	—	—	—	—	—	1	—	—	—	1	—
	Poplar	166,748	—	—	—	—	—	—	—	—	2	—	1	—
S. District.	St. Saviour, Southwark	27,377	—	—	—	—	—	—	—	—	—	—	—	—
	St. George, Southwark	56,712	1	—	—	—	—	—	1	—	—	—	1	—
	Newington	117,804	—	—	1	—	4	—	—	—	—	—	—	—
	St. Olave, Southwark	12,743	—	—	—	—	—	—	—	—	—	—	—	—
	Bermondsey	84,682	—	—	—	—	1	—	—	—	1	—	3	—
	Rotherhithe	30,255	—	—	—	—	—	—	—	—	—	—	—	—
	Lambeth	274,243	—	—	2	—	—	—	—	—	2	—	—	—
	Battersea	156,158	—	—	—	—	—	—	—	—	—	—	—	—
	Wandsworth	158,642	—	—	—	—	—	—	—	—	—	—	—	—
	Camberwell	235,344	4	—	4	1	2	—	—	—	3	—	10	—
	Greenwich	102,113	—	—	—	—	—	—	—	—	3	1	1	—
	Lewisham	92,617	—	—	1	—	—	—	—	—	1	—	—	—
	Woolwich	40,848	—	—	—	—	—	—	—	—	—	—	—	—
	Plumstead	88,539	—	—	1	—	—	—	2	—	—	—	—	—
	Port of London	—	2	—	2	—	—	—	1	—	—	—	—	—

* Including St. Peters, Westminster (population 235) † Including Middle Temple (population 36)

No. 12A.

ADMINISTRATIVE COUNTY of LONDON and for the COUNTY as a WHOLE, the NUMBER of NOTIFIED QUARTERLY and ANNUAL SUMMARIES of these Data for each of the AREAS in question.

Asylum's Board. The Deaths are extracted from the Weekly Returns compiled by the Registrar-General.]

SMALL-POX—*continued.*															
Weekly Statement, 1st Quarter, 1893—*continued.*													Totals for 1st Quarter, 1893.		Sanitary Areas.
Feb. 18.		Feb. 25.		March 4.		March 11.		March 18.		March 25.		April 1.			
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
48	—	53	3	55	4	55	5	56	2	90	5	58	5	559	31	London.
47	—	*53*	—	*49*	—	*53*	—	*54*	—	*87*	—	*59*	—	*541*	—	(*Administrative County.*)
—	—	5	—	—	—	—	1	—	—	1	—	—	—	6	2	Kensington.
—	—	1	—	—	—	1	—	1	—	1	—	4	—	8	—	Fulham.
—	—	—	1	—	—	—	—	3	1	—	—	—	—	3	2	Hammersmith.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Paddington.
—	—	—	—	—	—	—	—	—	—	1	—	—	—	7	—	Chelsea.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	St. George, Hanover Sq.*
1	—	—	—	2	—	—	—	1	—	7	—	3	—	19	—	Westminster.
—	—	—	—	—	—	—	—	—	—	1	—	1	—	2	—	St. James, Westminster.
1	—	1	1	2	—	2	—	4	—	9	—	4	—	34	1	St. Marylebone.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Hampstead.
—	—	1	—	—	—	2	—	4	—	3	—	4	—	22	1	St. Pancras.
—	—	3	—	4	—	11	—	2	—	10	—	2	—	49	—	Islington.
—	—	1	—	—	—	—	—	4	—	3	—	—	—	18	1	Hackney.
2	—	—	—	4	—	1	1	5	—	1	—	2	1	20	2	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	—	—	1	—	—	—	1	—	St. Martin-in-the-Fields.
1	—	—	—	—	—	1	—	—	—	2	—	—	—	4	—	Strand.†
1	—	—	—	—	—	—	—	—	—	—	—	1	1	2	1	Holborn.‡
1	—	1	—	—	—	1	—	1	—	—	—	3	—	7	—	Clerkenwell.
1	—	1	—	—	—	—	1	—	—	—	—	—	—	3	1	St. Luke, Middlesex.
—	—	1	1	—	—	1	—	1	—	2	—	—	—	5	1	London, City of.§
1	—	2	—	2	1	—	—	1	—	—	—	1	1	9	2	Shoreditch.
1	—	1	—	—	—	—	—	—	—	1	—	1	—	5	—	Bethnal Green.
7	—	4	—	1	—	10	1	4	—	10	—	1	—	45	2	Whitechapel.‖
10	—	6	—	5	—	—	—	1	—	1	—	—	1	29	1	St. George-in-the-East.
1	—	3	—	2	—	1	—	—	—	6	1	1	—	17	1	Limehouse.
—	—	—	—	—	—	2	—	2	—	2	—	3	—	11	—	Mile End Old Town.
8	—	7	—	16	—	2	—	4	—	4	—	3	—	47	—	Poplar.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	St. Saviour, Southwark.
2	—	1	—	2	—	—	—	—	—	1	—	1	—	9	—	St. George, Southwark.
—	—	—	—	—	—	—	—	2	—	—	—	2	—	9	1	Newington.
1	—	—	—	5	1	—	—	—	—	—	—	—	—	6	1	St. Olave, Southwark.
—	—	—	—	1	—	5	—	—	1	1	—	—	—	12	1	Bermondsey.
1	—	1	—	—	—	—	—	2	—	—	—	—	—	4	—	Rotherhithe.
—	—	1	—	—	—	2	1	1	—	—	—	—	—	8	1	Lambeth.
—	—	1	—	1	—	1	—	—	—	1	—	1	—	5	—	Battersea.
1	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Wandsworth.
1	—	8	—	2	1	1	—	1	—	3	1	1	—	40	3	Camberwell.
5	—	1	—	4	1	4	—	4	—	16	2	9	1	47	5	Greenwich.
1	—	—	—	—	—	—	—	2	—	—	1	5	—	10	1	Lewisham.
—	—	1	—	1	—	6	—	5	—	2	—	4	—	19	—	Woolwich.
—	—	1	—	—	—	1	—	1	—	—	—	1	—	7	—	Plumstead.
—	—	—	—	1	—	—	—	—	—	—	—	—	—	6	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

§ Including Inner Temple (population, 96).

‖ Including Tower of London (population, 868).

Sanitary Areas.	Population (1891).	SMALL-POX—*continued.* Weekly Statement, 2nd Quarter, 1893. April 8. Cases.	April 8. Deaths.	April 15. Cases.	April 15. Deaths.	April 22. Cases.	April 22. Deaths.	April 29. Cases.	April 29. Deaths.	May 6. Cases.	May 6. Deaths.	May 13. Cases.	May 13. Deaths.
London	4,232,118	*101	2	155	3	197	8	118	6	169	9	149	12
(Unresidential County)		77	—	61	—	103	—	67	—	66	—	64	—
W. District. Kensington	166,398	1	—	1	—	1	—	3	—	2	1	2	—
W. District. Fulham	91,649	1	—	2	—	—	—	2	—	2	1	2	—
W. District. Hammersmith	97,439	4	—	1	—	1	—	—	—	3	—	1	—
W. District. Paddington	117,846	—	—	5	—	2	1	6	—	—	—	3	—
W. District. Chelsea	90,954	—	—	3	—	1	—	4	—	3	—	1	—
W. District. St. George, Hanover Sq.*	78,239	—	—	2	—	2	1	—	1	1	—	—	—
W. District. Westminster	56,939	5	—	2	—	1	—	2	—	4	—	5	—
W. District. St. James, Westminster	24,997	—	—	1	—	—	—	2	—	—	—	—	—
N. District. St. Marylebone	142,804	1	—	15	—	13	—	9	—	16	—	9	—
N. District. Hampstead	68,816	2	—	—	—	1	—	—	—	3	—	1	—
N. District. St. Pancras	234,879	1	—	5	—	9	—	4	—	11	—	7	—
N. District. Islington	319,143	7	—	13	—	4	—	4	—	5	—	5	—
N. District. Hackney	220,542	—	—	3	—	—	—	3	—	2	—	—	—
Central District. St. Giles and St. George, Bloomsbury.	39,782	2	—	9	—	2	—	8	—	8	1	5	1
Central District. St. Martin-in-the-Fields	14,616	—	—	2	—	1	1	—	1	—	—	—	—
Central District. Strand	13,217	1	—	9	—	2	—	4	—	5	—	—	1
Central District. Holborn	34,048	1	—	1	—	6	—	—	—	3	—	4	—
Central District. Clerkenwell	63,246	1	—	1	—	—	—	—	—	1	—	—	—
Central District. St. Luke, Middlesex	42,849	—	—	1	—	—	—	—	—	1	—	1	—
Central District. London City of§	37,583	1	—	1	—	3	—	1	1	1	—	2	—
E. District. Shoreditch	124,699	1	—	4	—	—	—	—	—	1	—	—	—
E. District. Bethnal Green	129,182	3	—	—	—	1	—	1	—	2	—	3	—
E. District. Whitechapel	74,439	7	1	4	—	—	2	5	—	9	—	2	—
E. District. St. Georges-in-the-East	46,736	1	—	—	—	2	—	2	—	2	—	—	—
E. District. Limehouse	52,376	8	—	5	—	2	—	2	—	6	—	2	1
E. District. Mile End Old Town	167,592	11	—	5	—	10	—	5	—	12	1	4	1
E. District. Poplar	168,748	9	—	4	—	5	—	5	1	11	—	9	2
S. District. St. Saviour, Southwark	57,577	—	—	—	—	1	—	—	—	—	—	—	—
S. District. St. George, Southwark	52,772	3	—	3	1	2	—	2	—	2	—	3	—
S. District. Newington	117,804	—	—	1	—	—	—	4	—	3	—	5	—
S. District. St. Olave, Southwark	18,736	1	—	—	—	—	—	—	—	1	—	1	—
S. District. Bermondsey	94,682	—	—	5	—	—	—	4	—	1	1	7	—
S. District. Rotherhithe	36,855	—	—	—	—	—	—	16	1	23	1	11	2
S. District. Lambeth	253,295	3	—	4	—	4	—	2	—	2	—	4	—
S. District. Battersea	159,598	—	—	3	—	1	—	1	1	1	—	5	1
S. District. Wandsworth	178,842	—	—	—	—	—	—	1	—	3	—	1	1
S. District. Camberwell	240,944	5	—	7	1	9	—	3	—	6	—	3	1
S. District. Greenwich	109,423	19	—	26	—	12	3	11	—	7	—	3	—
S. District. Lewisham	[illegible]	7	—	1	1	5	—	—	—	3	2	—	—
S. District. Woolwich	46,818	—	—	1	—	2	—	—	—	3	1	2	—
S. District. Plumstead	85,240	1	1	5	—	2	—	4	—	3	—	6	1
S. District. Outside London	—	—	—	—	—	—	—	—	—	—	—	—	—

* [illegible]

† Including Middle Temple (population 99).

‡ Including St. Peters, Westminster (population 240).

SMALL-POX—*continued.*

Weekly Statement, 2nd Quarter, 1893—*continued.*														Totals for 2nd Quarter, 1893.		Sanitary Areas.
May 20.		May 27.		June 3.		June 10.		June 17.		June 24.		July 1.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
125	3	142	15	139	9	91	6	111	6	100	8	78	3	1,555	90	London.
122	—	*131*	—	*135*	—	*83*	—	*104*	—	*94*	—	*76*	—	*1,495*	—	(*Administrative County.*)
4	—	—	1	1	—	—	—	1	—	1	—	—	—	17	2	Kensington.
4	—	—	—	2	—	—	—	—	—	1	—	—	—	16	1	Fulham.
—	—	—	—	1	—	—	—	—	—	2	—	1	1	14	1	Hammersmith.
2	—	8	—	4	1	2	1	—	—	—	—	—	—	32	3	Paddington.
—	—	2	—	5	—	1	—	—	—	—	—	1	—	21	—	Chelsea.
2	—	3	1	—	—	—	—	2	—	2	—	—	—	14	3	St. George, Hanover Sq.*
—	—	—	—	2	—	1	—	2	—	1	—	—	—	25	—	Westminster.
—	—	2	—	—	—	4	—	16	—	14	—	7	—	46	—	St. James, Westminster.
12	—	17	—	11	2	4	—	5	—	7	—	4	—	123	2	St. Marylebone.
3	1	1	1	1	—	—	—	—	—	—	—	—	—	12	2	Hampstead.
5	—	7	1	9	—	6	1	5	1	5	1	5	—	79	4	St. Pancras.
4	—	4	—	3	—	2	—	2	—	2	—	4	—	59	—	Islington.
3	—	1	—	1	—	1	—	2	—	2	—	1	—	19	—	Hackney.
3	—	3	—	1	—	6	—	2	—	5	—	1	—	50	2	St. Giles and St. George, Bloomsbury.
1	—	1	—	1	—	1	—	—	—	1	—	1	—	9	2	St. Martin-in-the-Fields.
—	—	—	—	—	—	3	—	1	—	—	—	1	—	26	1	Strand.†
2	—	5	—	2	—	—	—	4	—	—	—	—	—	28	—	Holborn.‡
—	—	—	—	1	—	—	—	1	—	—	—	—	—	5	—	Clerkenwell.
2	—	1	—	2	—	—	—	1	—	3	—	—	—	12	—	St. Luke, Middlesex.
1	—	4	—	3	1	—	—	2	—	—	—	1	—	20	2	London, City of.§
4	—	—	—	1	—	1	—	—	—	—	—	1	—	13	—	Shoreditch.
1	—	4	—	2	—	4	—	1	—	1	1	—	—	23	1	Bethnal Green.
11	—	1	—	5	—	3	—	2	—	1	—	1	—	51	3	Whitechapel.‖
1	—	1	—	—	—	2	—	2	—	2	—	—	—	15	—	St. George-in-the-East.
3	—	7	—	3	—	—	—	3	2	5	—	3	1	49	4	Limehouse.
4	—	6	1	4	—	3	—	2	—	6	—	1	—	73	3	Mile End Old Town.
5	—	1	2	7	—	5	—	5	—	7	1	3	—	76	6	Poplar.
—	—	—	—	—	—	1	—	5	—	—	—	—	—	7	—	St. Saviour, Southwark.
7	—	9	2	10	2	5	—	8	—	2	—	3	—	59	5	St. George, Southwark.
5	1	1	—	2	—	9	—	11	—	5	1	4	—	50	2	Newington.
—	—	—	—	1	—	1	—	—	—	1	—	—	—	6	—	St. Olave, Southwark.
6	—	5	—	—	1	2	—	3	—	2	—	3	—	38	2	Bermondsey.
12	1	1	4	6	—	—	1	3	—	2	2	1	—	73	12	Rotherhithe.
1	—	7	—	8	1	4	—	4	—	4	—	16	—	63	1	Lambeth.
1	—	16	—	5	—	11	—	1	1	3	—	9	1	57	4	Battersea.
1	—	1	—	5	—	1	—	—	—	1	—	1	—	17	1	Wandsworth.
9	—	5	1	11	1	1	2	3	—	5	—	2	—	69	6	Camberwell.
1	—	6	—	11	—	4	1	6	1	3	2	3	—	112	7	Greenwich.
2	—	—	1	1	—	1	—	—	—	—	—	—	—	14	4	Lewisham.
1	—	7	—	2	—	2	—	4	1	1	—	—	—	25	2	Woolwich.
2	—	3	—	5	—	—	—	2	—	2	—	—	—	35	2	Plumstead.
—	—	2	—	—	—	—	—	—	—	1	—	—	—	3	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).
§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

	Sanitary Areas.	Population (1891).	SMALL-POX—*continued.* Weekly Statement, 3rd Quarter, 1893. July 8. Cases.	July 8. Deaths.	July 15. Cases.	July 15. Deaths.	July 22. Cases.	July 22. Deaths.	July 29. Cases.	July 29. Deaths.	Aug. 5. Cases.	Aug. 5. Deaths.	Aug. 12 Cases.	Aug. 12 Deaths.
	London	4,232,118	*75	9	74	3	55	10	48	8	47	3	26	2
	(Administrative County)		*71	—	70	—	53	—	46	—	42	—	20	—
W. District	Kensington	166,308	1	1	1	—	2	—	—	—	1	—	—	—
	Fulham	91,539	1	—	—	—	—	—	—	—	—	—	—	—
	Hammersmith	97,239	1	—	—	—	—	—	—	—	—	—	—	—
	Paddington	117,846	—	—	1	—	2	—	1	—	3	—	1	—
	Chelsea	86,253	1	—	1	—	—	—	—	—	—	—	—	—
	St. George, Hanover Sq.*	78,599	1	—	—	—	1	—	—	—	2	—	—	—
	Westminster	55,539	—	—	—	—	—	—	—	—	—	—	1	—
	St. James, Westminster	24,695	3	—	1	—	1	1	1	—	1	—	—	—
N. District.	St. Marylebone	142,304	5	—	1	—	2	—	5	—	6	1	2	—
	Hampstead	68,416	1	—	—	—	—	—	—	—	—	—	—	—
	St. Pancras	224,379	—	1	3	—	1	1	1	—	6	—	1	—
	Islington	319,143	—	—	2	—	5	—	—	2	—	—	—	—
	Hackney	229,542	3	1	6	—	1	1	3	—	2	—	—	—
Central District.	St. Giles and St. George, Bloomsbury	39,782	3	—	2	—	1	—	—	—	—	—	—	—
	St. Martin-in-the-Fields	14,616	—	—	—	—	—	—	—	—	—	—	—	—
	Strand*	25,217	1	—	—	—	1	—	—	—	1	—	—	—
	Holborn†	34,043	—	—	1	—	—	—	1	—	1	—	—	—
	Clerkenwell	66,246	—	—	—	—	—	—	2	—	—	—	—	—
	St. Luke, Middlesex	42,340	—	—	1	—	—	—	—	—	—	—	—	—
	London, City of §	37,583	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Shoreditch	124,009	—	—	2	—	1	—	—	—	—	—	—	—
	Bethnal Green	129,132	5	—	6	—	2	1	4	1	8	—	1	—
	Whitechapel	74,420	2	—	2	—	—	—	—	—	—	—	—	—
	St. George-in-the-East	45,795	1	—	1	—	—	—	—	—	—	—	—	—
	Limehouse	57,376	2	2	3	—	—	—	—	—	—	—	—	—
	Mile End Old Town	107,592	3	—	2	—	2	—	8	—	2	2	1	1
	Poplar	166,748	2	—	3	—	1	—	1	—	4	—	3	—
S. District.	St. Saviour, Southwark	27,177	—	—	1	—	—	—	—	—	—	—	—	—
	St. George, Southwark	59,712	—	1	1	—	3	—	1	1	—	—	—	—
	Newington	115,804	4	—	1	1	2	—	—	—	1	—	4	—
	St. Olave, Southwark	12,723	—	—	—	—	—	—	—	—	—	—	—	—
	Bermondsey	84,682	2	1	—	—	—	—	1	—	1	—	2	—
	Rotherhithe	39,995	3	—	—	—	5	—	1	1	2	—	—	—
	Lewisham	275,203	4	1	9	—	1	1	4	1	3	—	3	—
	Battersea	159,568	10	—	8	2	14	4	7	1	2	—	4	—
	Wandsworth	150,512	2	—	2	—	1	—	1	—	—	—	2	—
	Camberwell	283,344	6	1	3	—	2	—	3	—	2	—	1	—
	Greenwich	165,313	6	—	4	—	—	1	—	—	—	—	—	—
	Lewisham	91,447	—	—	—	—	—	—	—	—	—	—	—	—
	Woolwich	61,848	1	—	1	—	2	—	—	1	—	—	—	1
	Plumstead	88,530	1	—	—	—	2	—	3	—	—	—	—	—
	Port of London	—	—	—	—	—	—	—	—	—	—	—	—	—

* Including *notifications*.

† Including St. Peters, Westminster (population, 236).

‡ Including Middle Temple (population, 64).

§ Including Inner Temple (population, 64).

SMALL-POX—*continued.*

Weekly Statement, 3rd Quarter, 1893—*continued.*													Totals for 3rd Quarter, 1893.		Sanitary Areas.
Aug. 19.		Aug. 26.		Sept. 2.		Sept. 9.		Sept. 16.		Sept. 23.		Sept. 30.			
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
33	3	29	2	13	2	33	—	26	1	19	2	19	2	496	47	London.
32	—	*24*	—	*12*	—	*28*	—	*25*	—	*17*	—	*18*	—	*464*	—	(*Administrative County.*)
—	—	—	—	—	—	—	—	1	—	—	—	—	—	6	1	Kensington.
—	—	—	—	1	—	—	—	—	—	—	—	2	—	4	—	Fulham.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Hammersmith.
1	1	1	—	—	—	—	—	—	—	—	—	1	—	11	1	Paddington.
—	—	—	—	—	—	—	—	1	—	—	—	—	—	3	—	Chelsea.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	St. George, Hanover Sq.*
—	—	—	—	—	—	1	—	2	—	—	—	—	—	4	—	Westminster.
1	—	—	—	—	—	—	—	—	—	—	—	—	—	8	1	St. James, Westminster.
1	—	—	1	—	—	—	—	—	—	—	—	—	—	22	2	St. Marylebone.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Hampstead.
—	—	—	—	2	—	—	—	—	—	—	—	—	—	14	2	St. Pancras.
1	—	—	—	3	—	—	—	—	—	—	—	—	—	11	2	Islington.
3	—	—	—	2	—	3	—	1	—	3	—	1	1	28	3	Hackney.
—	—	—	—	—	—	—	—	1	—	—	—	—	—	7	—	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	—	—	1	—	—	—	1	—	St. Martin-in-the-Fields.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	Strand.†
—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	Holborn.‡
—	—	2	—	—	—	1	—	—	—	—	—	—	—	5	—	Clerkenwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	St. Luke, Middlesex.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	London, City of.§
1	—	—	—	—	—	1	—	2	1	2	—	—	—	9	1	Shoreditch.
1	—	6	—	1	2	15	—	2	—	2	2	3	—	55	6	Bethnal Green.
—	—	1	—	—	—	—	—	—	—	—	—	—	—	5	—	Whitechapel.‖
—	—	—	—	1	—	2	—	1	—	—	—	—	—	6	—	St. George-in-the-East.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	5	2	Limehouse.
2	—	—	—	—	—	1	—	1	—	2	—	—	1	23	4	Mile End Old Town.
9	1	1	—	1	—	2	—	8	—	—	—	3	—	43	1	Poplar.
1	—	2	—	—	—	3	—	—	—	4	—	—	—	11	—	St. Saviour, Southwark.
2	—	1	—	—	—	—	—	2	—	—	—	6	—	16	2	St. George, Southwark.
—	1	—	1	—	—	—	—	—	—	1	—	—	—	13	3	Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Olave, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	6	1	Bermondsey.
2	—	1	—	—	—	—	—	—	—	—	—	—	—	14	1	Rotherhithe.
2	—	2	—	1	—	—	—	—	—	—	—	—	—	29	3	Lambeth.
1	—	4	—	—	—	1	—	—	—	1	—	2	—	54	7	Battersea.
—	—	3	—	1	—	—	—	—	—	1	—	—	—	13	—	Wandsworth.
2	—	1	—	—	—	2	—	1	—	1	—	2	—	26	1	Camberwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	10	1	Greenwich.
—	—	1	—	—	—	—	—	—	—	1	—	—	—	2	—	Lewisham.
1	—	2	—	—	—	—	—	—	—	—	—	—	—	7	2	Woolwich.
—	—	1	—	—	—	1	—	3	—	—	—	—	—	11	—	Plumstead.
1	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).
§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

Sanitary Areas.	Population (1891).	SMALL POX *continued*. Weekly Statement, 4th Quarter, 1893. Oct. 7. Cases.	Oct. 7. Deaths.	Oct. 14. Cases.	Oct. 14. Deaths.	Oct. 21. Cases.	Oct. 21. Deaths.	Oct. 28. Cases.	Oct. 28. Deaths.	Nov. 4. Cases.	Nov. 4. Deaths.	Nov. 11. Cases.	Nov. 11. Deaths.	Nov. 18. Cases.	Nov. 18. Deaths.
London	4,232,118	5	1	17	2	13	—	31	2	36	1	61	2	23	1
(*Administrative County*)		78	—	47	—	48	—	80	—	67	—	88	—	37	—
W. District. Kensington	166,838	1	—	—	—	1	—	6	1	13	—	21	—	8	—
W. District. Fulham	91,620	—	1	—	—	—	—	2	—	—	—	—	—	—	—
W. District. Hammersmith	87,249	—	—	—	—	—	—	—	—	—	—	—	—	—	—
W. District. Paddington	117,842	—	—	—	—	—	—	3	—	—	—	2	—	—	—
W. District. Chelsea	66,670	—	—	—	—	—	—	—	—	2	—	8	1	—	—
W. District. St. George, Hanover Sq.*	78,450	—	—	—	—	2	—	—	—	1	—	—	—	—	—
W. District. Westminster	35,439	1	—	—	—	—	—	—	—	—	—	—	—	—	—
W. District. St. James, Westminster	24,295	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N. District. St. Marylebone	142,401	—	—	1	—	1	—	—	—	—	—	1	—	—	—
N. District. Hampstead	68,416	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N. District. St. Pancras	234,879	—	—	—	—	1	—	1	—	—	—	1	—	—	—
N. District. Islington	317,443	1	—	—	—	—	—	—	—	—	—	—	—	—	—
N. District. Hackney	220,542	1	—	—	—	1	—	—	—	—	—	—	—	—	—
Central District. St. Giles and St. George, Bloomsbury	39,782	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Central District. St. Martin-in-the-Fields	14,616	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Central District. Strand*	25,217	—	—	—	—	—	—	—	—	—	—	1	—	—	—
Central District. Holborn†	31,833	1	—	—	—	1	—	—	—	—	—	—	—	—	—
Central District. Cornwall	60,160	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Central District. St. Luke, Middlesex	12,410	—	—	—	—	—	—	1	—	—	—	—	—	—	—
Central District. London, City of	37,581	—	—	—	—	—	—	—	—	—	—	1	—	1	—
E. District. Shoreditch	124,009	—	—	—	—	—	—	—	—	—	—	—	—	—	—
E. District. Bethnal Green	129,132	3	—	2	—	1	—	—	—	—	—	1	—	—	—
E. District. Whitechapel	74,420	—	—	1	—	—	—	—	—	—	—	—	—	—	—
E. District. St. George-in-the-East	45,795	1	—	—	—	—	—	—	—	1	—	—	—	—	—
E. District. Limehouse	57,376	—	—	1	—	1	—	3	—	5	—	—	1	3	—
E. District. Mile End Old Town	137,592	—	—	1	—	—	—	—	—	—	—	—	—	—	1
E. District. Poplar	166,748	1	—	2	1	2	—	10	—	6	1	12	—	7	—
S. District. St. Saviour Southwark	47,177	2	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District. St. George, Southwark	35,777	—	—	—	—	—	—	—	—	—	—	—	—	1	—
S. District. Newington	115,804	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District. St. Olave, Southwark	14,743	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District. Bermondsey	84,887	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District. Rotherhithe	41,849	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District. Lewisham	274,076	—	—	1	—	—	—	1	—	—	—	1	—	1	—
S. District. Battersea	168,688	1	—	1	1	1	—	1	—	2	—	1	—	—	—
S. District. Wandsworth	148,842	—	—	—	—	—	—	—	—	—	—	1	—	1	—
S. District. Clapham	25,643	1	—	1	—	1	—	—	1	—	—	—	—	—	—
S. District. Greenwich	103,836	1	—	—	—	1	—	1	—	1	—	2	—	—	—
S. District. Lewisham	38,291	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District. Woolwich	30,845	—	—	5	—	—	—	1	—	2	—	1	—	—	—
S. District. Plumstead	38,598	—	—	—	—	—	—	1	—	—	—	—	—	—	—
S. District. Outside London	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—

Asylums Board of [illegible]

* Including St. James, Westminster (population, 235). † Including Middle Temple (population [illegible])

SMALL POX—*continued.*

Weekly Statement, 4th Quarter, 1893—*continued.*												Totals for 4th Quarter, 1893.		Grand Totals for Year 1893.		Sanitary Areas.
Nov. 25.		Dec. 2.		Dec. 9.		Dec. 16.		Dec. 23.		Dec. 30.						
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
18	3	32	—	26	3	27	2	22	1	19	—	338	18	2,948	186	London.
18	—	*32*	—	*20*	—	*24*	—	*21*	—	*15*	—	*343*	—	*2,813*	—	(*Administrative County.*)
5	1	9	—	8	2	1	1	3	—	1	—	77	5	106	10	Kensington.
—	—	1	—	—	—	—	—	—	—	—	—	5	1	33	2	Fulham.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	18	3	Hammersmith.
2	—	5	—	2	—	5	—	3	—	1	—	30	—	73	4	Paddington.
1	—	1	—	—	—	2	—	—	—	2	—	14	1	45	1	Chelsea.
—	—	1	—	—	—	—	—	—	—	—	—	4	—	24	3	St. George, Hanover Sq.*
—	—	—	—	—	—	—	—	—	—	—	—	1	—	49	—	Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	56	1	St. James, Westminster.
2	—	1	—	—	—	1	—	—	—	—	—	7	—	186	5	St. Marylebone.
—	—	1	—	—	—	—	—	—	—	—	—	1	—	14	2	Hampstead.
2	—	1	—	1	—	4	1	1	1	—	—	12	2	127	9	St. Pancras.
—	—	—	—	1	—	5	—	2	—	3	—	12	—	131	2	Islington.
—	—	—	—	—	—	—	—	—	—	—	—	2	—	67	4	Hackney.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	77	4	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	11	2	St. Martin-in-the-Fields.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	33	1	Strand.†
—	—	—	—	—	—	—	—	—	—	—	—	2	—	35	1	Holborn.‡
—	—	—	—	—	—	—	—	—	—	—	—	—	—	17	—	Clerkenwell.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	17	1	St. Luke, Middlesex.
—	—	—	—	—	—	—	—	—	—	—	—	2	—	27	3	London, City of.§
1	—	—	—	—	—	1	—	—	—	—	—	2	—	33	3	Shoreditch.
—	—	—	—	—	—	—	—	—	—	—	—	6	—	89	7	Bethnal Green.
—	—	—	—	1	—	—	—	—	—	—	—	2	—	103	5	Whitechapel.‖
—	—	—	—	—	—	—	—	—	—	—	—	2	—	52	1	St. George-in-the-East.
1	—	1	—	—	—	—	—	—	—	—	—	13	1	84	8	Limehouse.
1	—	1	—	—	—	1	—	1	—	4	—	9	1	116	8	Mile End Old Town.
1	2	7	—	4	1	2	—	3	—	—	—	60	5	226	12	Poplar.
—	—	—	—	—	—	—	—	—	—	—	—	2	—	21	—	St. Saviour, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	85	7	St. George, Southwark.
—	—	—	—	3	—	—	—	—	—	2	—	5	—	77	6	Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	12	1	St. Olave, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	56	4	Bermondsey.
—	—	—	—	—	—	—	—	—	—	1	—	1	—	92	13	Rotherhithe.
1	—	—	—	1	—	—	—	—	—	—	—	6	—	106	5	Lambeth.
—	—	—	—	—	—	1	—	—	—	—	—	8	1	124	12	Battersea.
1	—	—	—	—	—	—	—	—	—	—	—	3	—	34	1	Wandsworth.
—	—	—	—	—	—	—	—	—	—	—	—	7	1	142	11	Camberwell.
—	—	3	—	2	—	1	—	8	—	1	—	21	—	190	13	Greenwich.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	26	5	Lewisham.
—	—	—	—	1	—	1	—	—	—	3	—	12	—	63	4	Woolwich.
—	—	—	—	2	—	2	—	1	—	1	—	7	—	60	2	Plumstead.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	11	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).
§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

Sanitary Areas.	Population (1891).	Scarlet Fever. Weekly Statement, 1st Quarter, 1893. Jan. 7. Cases.	Jan. 7. Deaths.	Jan. 14. Cases.	Jan. 14. Deaths.	Jan. 21. Cases.	Jan. 21. Deaths.	Jan. 28. Cases.	Jan. 28. Deaths.	Feb. 4. Cases.	Feb. 4. Deaths.	Feb. 11. Cases.	Feb. 11. Deaths.
London	4,232,118	*498	33	394	35	451	25	443	35	449	30	448	19
(*Administrative County*)		*443	—	388	—	439		425	—	438	—	429	—
W. District. Kensington	166,908	15	1	8	1	15	1	8	—	6	2	38	—
W. District. Fulham	91,639	10	—	18	—	9	—	3	1	7	1	10	1
W. District. Hammersmith	97,399	4	1	7	2	10	—	13	2	8	—	4	—
W. District. Paddington	117,846	14	—	5	1	9	—	15	2	9	—	14	—
W. District. Chelsea	96,253	7	1	1	—	10	2	6	—	13	1	6	—
W. District. St. George, Hanover Sq.*	78,509	5	1	4	2	2	—	4	1	12	1	5	—
W. District. Westminster	55,589	1	—	2	1	1	—	3	—	6	—	—	—
W. District. St. James, Westminster	24,995	—	—	—	—	1	—	2	—	2	—	2	1
N. District. St. Marylebone	142,804	12	—	10	1	15	—	7	—	12	1	9	1
N. District. Hampstead	68,416	7	—	6	—	6	—	11	1	7	—	5	—
N. District. St. Pancras	234,379	21	3	15	—	32	1	27	3	23	2	20	2
N. District. Islington	319,143	31	3	34	2	52	3	41	3	28	2	30	—
N. District. Hackney	229,542	20	1	24	—	30	3	31	3	34	3	33	1
Central District. St. Giles and St. George, Bloomsbury	39,782	6	—	2	—	5	—	1	—	5	—	4	—
Central District. St. Martin-in-the-Fields	14,616	1	—	1	—	1	—	2	—	3	—	—	1
Central District. Strand†	25,217	—	—	1	—	—	—	2	—	2	1	1	—
Central District. Holborn‡	34,943	7	—	2	—	4	—	5	—	13	1	2	1
Central District. Clerkenwell	66,216	5	—	8	—	7	—	10	1	15	—	9	—
Central District. St. Luke, Middlesex	42,440	8	1	6	1	7	2	6	—	12	2	10	—
Central District. London, City of§	37,583	3	1	7	—	5	1	6	—	3	—	7	—
E. District. Shoreditch	124,909	7	—	18	—	12	1	6	—	11	—	15	1
E. District. Bethnal Green	129,432	12	1	16	2	11	—	14	—	11	—	9	—
E. District. Whitechapel	74,020	12	5	8	—	10	1	8	—	13	1	12	—
E. District. St. George-in-the-East	45,795	5	1	5	—	8	—	4	—	4	—	2	—
E. District. Limehouse	57,376	10	—	9	—	19	1	17	1	15	1	10	1
E. District. Mile End Old Town	107,592	17	—	11	1	18	—	14	2	14	1	15	—
E. District. Poplar	166,748	38	4	32	6	30	—	30	4	23	—	22	5
S. District. St. Saviour, Southwark	27,177	4	—	1	—	1	—	1	—	1	—	4	—
S. District. St. George, Southwark	59,712	2	—	7	1	1	—	2	1	5	—	1	—
S. District. Newington	145,804	5	1	10	1	16	—	13	1	6	—	9	—
S. District. St. Olave, Southwark	12,753	—	—	1	—	2	—	1	—	3	—	1	—
S. District. Bermondsey	84,682	9	1	7	2	7	—	12	—	3	—	9	—
S. District. Rotherhithe	36,256	1	—	2	—	3	—	—	—	—	—	3	—
S. District. Lambeth	273,293	21	2	18	1	18	3	21	1	24	—	30	3
S. District. Battersea	159,568	29	—	9	1	10	—	11	—	25	2	27	—
S. District. Wandsworth	126,202	8	2	15	2	12	1	12	2	9	1	10	—
S. District. Camberwell	232,444	28	1	30	1	21	—	35	3	14	3	11	2
S. District. Greenwich	103,413	14	1	21	2	26	2	21	2	20	1	23	—
S. District. Lewisham	92,647	5	—	3	—	6	2	3	—	16	—	5	—
S. District. Woolwich	40,848	6	—	2	1	2	—	6	—	5	—	—	—
S. District. Plumstead	88,539	18	—	8	1	8	1	9	1	5	1	12	1
Port of London	—	—	—	—	—	—	—	—	—	—	—	—	—

* Totals of actual *notifications*.
† Cases furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicate notifications.
‡ Including St. Peters, Westminster (population, 235). § Including Middle Temple (population, 95).

SCARLET FEVER—*continued.*

Weekly Statement, 1st Quarter, 1893—*continued.*														Totals for 1st Quarter, 1893.		Sanitary Areas.
Feb. 18.		Feb. 25.		March 4.		March 11.		March 18.		March 25.		April 1.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
392	26	317	19	336	21	363	14	331	30	302	17	336	29	5,092	332	London.
382	—	*309*	—	*325*	—	*334*	—	*319*	—	*312*	—	*330*	—	4,948	—	(*Administrative County.*)
11	—	11	1	12	2	7	—	8	1	15	—	10	2	164	10	Kensington.
8	1	10	1	9	1	6	—	13	2	11	—	18	1	134	9	Fulham.
9	—	6	—	—	—	7	2	3	—	3	—	5	—	73	7	Hammersmith.
6	—	8	—	8	—	5	—	7	—	9	—	3	1	112	4	Paddington.
4	—	13	—	3	—	7	1	8	—	5	—	11	—	94	5	Chelsea.
4	—	4	—	9	—	1	—	8	1	10	—	3	—	71	6	St. George, Hanover Sq.*
4	—	3	—	7	—	5	—	2	1	3	—	5	1	42	3	Westminster.
1	—	7	—	—	—	3	—	—	—	1	—	1	—	20	1	St. James, Westminster.
7	2	8	2	3	1	11	1	5	3	5	1	16	—	120	13	St. Marylebone.
7	—	5	—	5	—	8	—	8	1	5	—	7	—	87	2	Hampstead.
26	1	19	—	34	—	33	2	24	1	28	1	25	—	227	16	St. Pancras.
33	1	25	—	27	1	54	2	23	2	35	2	33	1	426	22	Islington.
26	1	22	1	19	1	20	1	20	1	27	—	27	—	342	16	Hackney.
2	1	1	—	1	—	4	—	2	—	1	—	—	—	34	1	St. Giles and St. Bloomsbury.
1	—	—	—	—	—	1	—	—	—	—	—	—	—	12	1	St. Martin-in-the-Fields.
6	2	4	—	1	—	2	1	—	—	2	—	2	—	23	4	Strand.†
4	—	1	—	—	—	1	—	1	—	1	—	3	—	44	2	Holborn.‡
4	—	2	—	6	—	3	—	3	—	8	—	5	—	85	1	Clerkenwell.
3	—	4	1	6	1	3	—	3	1	—	—	2	—	70	9	St. Luke, Middlesex.
3	—	1	—	1	—	5	—	2	—	1	—	3	—	47	2	London, City of.§
15	2	12	1	11	2	10	—	11	1	11	1	8	—	147	9	Shoreditch.
8	—	4	—	8	1	17	—	8	4	17	1	9	—	144	9	Bethnal Green.
13	—	7	—	7	—	11	—	6	—	4	—	9	2	120	9	Whitechapel.‖
5	1	3	1	4	—	4	—	5	—	7	—	3	—	59	3	St. George-in-the-East.
20	1	10	4	14	—	13	1	17	—	12	2	9	2	175	14	Limehouse.
9	—	10	—	21	—	9	—	17	1	24	—	9	—	188	5	Mile End Old Town.
19	2	15	—	13	3	17	—	22	3	20	2	12	3	298	32	Poplar.
4	3	3	—	—	—	1	—	2	2	1	—	4	—	27	5	St. Saviour, Southwark.
3	—	5	1	4	—	1	—	5	—	4	—	4	—	44	3	St. George, Southwark.
9	1	4	1	5	2	7	—	4	1	14	1	11	2	113	11	Newington.
3	—	2	—	2	—	1	—	—	—	1	—	—	—	17	—	St. Olave, Southwark.
4	2	9	2	4	—	7	—	9	1	6	—	4	—	90	8	Bermondsey.
4	—	1	—	—	—	2	—	1	—	1	1	2	—	20	1	Rotherhithe.
13	2	21	1	11	1	15	—	15	—	16	—	13	4	236	18	Lambeth.
39	1	17	1	16	2	10	1	21	—	23	—	15	3	252	11	Battersea.
16	—	4	—	15	—	13	—	12	1	13	—	10	3	158	12	Wandsworth.
20	1	9	1	12	2	13	1	13	2	26	3	12	1	244	23	Camberwell.
7	—	7	—	21	1	11	1	12	—	17	—	6	3	206	13	Greenwich.
2	—	6	—	4	—	4	—	2	—	1	1	2	—	59	3	Lewisham.
2	—	2	—	—	—	3	—	4	—	7	—	2	1	41	2	Woolwich.
8	1	12	—	13	—	8	—	5	—	6	1	13	—	125	7	Plumstead.
—	—	—	—	—	—	—	—	—	—	1	—	—	—	1	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).
§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

Sanitary Areas.	Population (1891).	Scarlet Fever—*continued*. Weeks Statement, 2nd Quarter, 1893.											
		April 8.		April 15.		April 22.		April 29.		May 6.		May 13.	
		Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
London	4,242,118	331	19	358	18	436	23	396	28	314	19	303	15
(*Administrative County*)		297	—	328	—	389	—	346	—	284	—	276	1
W. District. Kensington	166,308	9		8	—	9	—	10		21	—	11	2
Fulham	91,849	13	1	13	2	21	1	8	—	4	1	9	—
Hammersmith	97,239	8		8	1	9	1	7	2	15	—	10	—
Paddington	137,846	7	—	14	1	10	1	8	1	16	—	7	—
Chelsea	66,236	9	—	4	—	13	1	10	—	11	—	8	—
St. George Hanover Sq.*	78,540	4		7	—	18	1	6		9	—	11	1
Westminster	53,549	3	—	2	—	3	1	2	1	4	—	15	—
St. James, Westminster	24,057	1	—	—	—	—	—	2	—	1	—	8	—
N. District. St. Marylebone	142,464	14	—	7	—	12	1	10	2	10	—	14	—
Hampstead	68,126	8	1	3	—	17	1	14	1	11	—	9	2
St. Pancras	234,579	20	2	26	1	20	—	23	3	24	—	28	—
Islington	353,143	40	—	35	1	26	—	24	1	33	2	42	2
Hackney	229,342	23	1	24	1	16	1	29	1	36	1	30	—
Central District. St. Giles and St. George, Bloomsbury	39,782	2	2	1	1	1	—	6	1	3	—	4	—
St. Martin-in-the-Fields	14,616	4	—	2		1	—	—	—	2	—	1	—
Strand†	25,817	2	—	1	—	2	1	1	1	3	—	1	—
Holborn‡	34,493	3	—	1	—	4	1	2	—	3	—	4	—
Clerkenwell‖	62,516	11	—	10	—	9	2	13	—	12	—	18	1
St. Luke, Middlesex	42,110	2	—	3	—	4	1	3	—	3	1	4	1
London, City of§	37,586	3	—	—	—	3	—	3	—	8	—	3	—
E. District. Shoreditch	124,069	15	—	13	1	13	1	7	1	20	1	26	—
Bethnal Green	129,332	7	1	6	1	12	2	10	1	20	1	15	3
Whitechapel‡	74,170	12	—	3	—	4	—	14	—	15	—	16	—
St. George-in-the-East	42,755	4	—	—	—	6	—	4	—	7	—	2	—
Limehouse	97,876	11	2	6	—	8	1	7	1	9	—	9	—
Mile End Old Town	146,592	23	1	18	—	19	1	18	1	12	1	15	1
Poplar	166,748	26	1	24	3	25	—	33	1	26	3	25	—
S. District. St. Saviour, Southwark	27,377	—	—	—	—	3	—	1	1	4	—	3	—
St. George, Southwark	205,2[illegible]	4	—	3	1	11	1	5	—	1	1	14	—
Newington	117,884	12	2	14	1	13	—	12	1	12	—	10	—
St. Olave, Southwark	12,739	3	—	3		2	—	4	1	—	—	—	—
Bermondsey	84,882	8	—	3	1	5	—	6	—	11	2	8	1
Rotherhithe	37,[illegible]	6	—	2	—	4	1	3	—	2	—	4	—
Lambeth	275,[illegible]	19	2	24	—	29	—	30	2	17	1	25	—
Battersea	129,[illegible]	32	2	17	1	17	—	32	1	27	—	27	—
Wandsworth	156,[illegible]	13	—	9	—	14	2	15	2	29	2	22	—
Camberwell	245,[illegible]	14	—	16	—	15	—	23	1	13	1	20	1
Greenwich	102,[illegible]	16	1	9	—	14	1	19	—	10	—	11	—
Lewisham	92,[illegible]	5	—	6	—	7	—	1	—	6	—	1	—
Woolwich	40,[illegible]	1	—	1	—	1	—	3	—	7	1	4	—
Plumstead	88,[illegible]	11	—	5	1	8	—	15	—	17	—	23	—
Part of London	—	—	—	—	—	—	—	—	—	—	—	—	—

* Including St. Peters, Westminster (population, 2[illegible]). † Including Middle Temple (population [illegible]).

SCARLET FEVER—*continued.*

Weekly Statement, 2nd Quarter, 1893—*continued.*														Totals for 2nd Quarter, 1893.		Sanitary Areas.
May 20.		May 27.		June 3.		June 10.		June 17.		June 24.		July 1.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
641	25	554	29	679	27	772	24	797	38	863	29	956	38	8,000	333	London,
630	—	*539*	—	*660*	—	*752*	—	*775*	—	*835*	—	*931*	—	*7,779*	—	(*Administrative County.*)
17	4	15	1	16	—	20	2	37	—	18	2	20	1	214	12	Kensington.
13	—	10	1	12	3	15	—	17	—	18	1	17	—	167	10	Fulham.
17	—	15	—	8	—	16	2	24	1	14	—	23	—	183	7	Hammersmith.
23	1	11	—	13	—	20	—	20	2	21	—	28	1	198	7	Paddington.
11	—	10	—	18	1	13	1	18	2	9	1	11	1	145	7	Chelsea.
11	—	14	1	9	2	15	3	13	1	10	1	15	1	138	11	St. George, Hanover Sq.*
6	2	6	—	16	—	9	—	8	1	8	—	13	—	95	5	Westminster.
1	1	1	—	5	—	5	—	5	—	2	—	4	—	35	1	St. James, Westminster.
22	1	13	2	20	—	17	1	26	2	33	1	31	1	238	11	St. Marylebone.
13	—	9	2	17	1	12	—	15	—	15	—	20	—	164	8	Hampstead.
39	2	41	2	46	3	52	2	53	1	70	2	57	1	507	19	St. Pancras.
41	1	48	2	63	2	72	—	58	1	81	4	82	4	672	20	Islington.
55	—	25	2	46	—	44	—	28	3	45	—	57	3	483	13	Hackney.
—	—	8	—	9	—	6	1	2	1	4	—	8	1*	54	7	St. Giles and St. George, Bloomsbury.
2	—	—	—	10	—	3	—	4	—	3	—	5	—	37	—	St. Martin-in-the-Fields.
2	1	3	—	4	—	4	—	—	1	1	—	1	1	25	5	Strand.†
3	—	7	—	3	—	1	—	8	1	5	—	7	—	58	2	Holborn.‡
12	—	15	1	16	—	18	—	38	—	24	1	17	4	213	9	Clerkenwell.
2	—	5	—	5	—	14	1	8	—	4	—	14	—	71	4	St. Luke, Middlesex.
11	—		1	6	—	13	—	4	—	2	1	23	—	87	2	London, City of.§
13	1	23	—	17	1	22	—	9	—	18	1	20	—	206	7	Shoreditch.
18	1	13	—	19	2	31	2	25	2	42	2	46	1	264	19	Bethnal Green.
21	—	2	—	11	—	12	1	21	2	19	—	11	—	161	3	Whitechapel.‖
4	—	7	—	9	—	8	—	7	—	11	—	10	—	86	—	St. George-in-the-East.
3	1	5	4	5	—	12	—	6	—	6	—	14	1	101	10	Limehouse.
27	1	17	—	27	2	30	1	20	—	29	2	30	2	283	13	Mile End Old Town.
37	3	51	1	31	2	25	2	40	3	41	1	22	2	406	22	Poplar.
6	1	4	—	2	—	7	1	12	1	14	—	10	1	65	5	St. Saviour, Southwark.
12	—	8	1	19	—	17	1	14	2	22	2	29	2	158	11	St. George, Southwark.
15	—	17	1	16	1	20	—	21	—	29	—	32	1	223	7	Newington.
1	—	2	—	4	—	2	—	3	—	1	—	2	1	27	2	St. Olave, Southwark.
14	—	9	2	13	1	14	—	16	—	20	3	12	1	141	11	Bermondsey.
3	—	3	1	4	1	5	—	4	—	9	—	10	—	61	3	Rotherhithe.
35	1	23	—	41	3	39	—	46	2	56	—	58	2	442	13	Lambeth.
29	—	20	—	24	—	34	2	26	—	31	1	31	—	347	7	Battersea.
26	1	16	—	22	—	28	—	47	1	37	—	49	—	327	8	Wandsworth.
29	—	29	2	25	—	43	—	32	3	25	1	41	—	335	9	Camberwell.
20	—	14	1	18	—	28	—	40	2	31	1	29	3	250	9	Greenwich.
9	—	5	—	5	—	11	—	10	—	10	—	25	1	101	1	Lewisham.
1	—	5	1	9	—	7	—	2	1	6	1	4	1	51	5	Woolwich.
17	2	17	—	16	2	8	1	10	2	19	—	18	—	181	8	Plumstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

	Sanitary Areas.	Population (1891).	SCARLET FEVER *continued*. Weekly Returns, 3rd Quarter, 1893.									
			July 8.		July 15.		July 22.		July 29.		Aug. 5.		Aug. 12.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
	London	4,232,118	968	35	993	34	1,026	36	1,003	36	1,072	44	927	26
	(*Administrative County*)		930	—	952	—	997	—	968	—	1,030	—	892	—
W. District.	Kensington	166,308	30	—	24	1	31	1	26	1	24	1	30	—
	Fulham	91,633	14	1	12	—	17	1	16	1	15	—	11	—
	Hammersmith	97,239	28	1	18	2	24	—	29	—	29	3	11	2
	Paddington	117,846	31	—	38	2	30	1	24	1	35	—	16	1
	Chelsea	86,253	11	—	10	—	16	1	20	3	13	1	10	2
	St. George, Hanover Sq.*	78,570	21	1	17	—	28	—	19	—	15	1	15	—
	Westminster	55,539	11	—	7	1	11	1	13	3	13	—	9	—
	St. James, Westminster	24,995	2	—	5	—	—	—	2	—	4	—	3	—
N. District.	St. Marylebone	142,404	23	—	26	1	38	4	20	3	26	3	10	2
	Hampstead	68,416	7	—	20	—	14	—	9	—	7	—	11	—
	St. Pancras	234,379	64	1	80	—	78	6	104	4	113	6	70	4
	Islington	319,143	88	—	69	2	68	—	68	2	103	2	78	—
	Hackney	220,542	44	4	70	2	63	2	75	2	64	2	52	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	5	—	4	—	9	1	2	—	4	—	2	—
	St. Martin-in-the-Fields	14,616	5	—	4	—	2	1	—	—	2	—	—	—
	Strand†	25,217	5	—	5	—	4	—	3	—	5	—	4	1
	Holborn‡	34,043	24	—	18	2	7	1	8	—	14	—	11	1
	Clerkenwell	68,216	26	4	34	2	16	1	18	1	14	—	20	1
	St. Luke, Middlesex	42,440	8	—	7	—	13	—	14	4	13	3	6	—
	London, City of§	37,583	4	—	3	—	7	—	2	—	5	—	1	—
E. District.	Shoreditch	124,009	20	1	31	2	30	1	19	1	17	1	25	1
	Bethnal Green	129,132	35	2	35	1	61	1	29	1	56	1	46	—
	Whitechapel	74,420	26	1	29	1	36	—	35	—	27	2	37	1
	St. George-in-the-East	45,795	11	1	6	—	16	1	9	—	8	2	9	—
	Limehouse	57,376	11	1	10	—	7	—	12	—	9	1	13	—
	Mile End Old Town	107,592	33	1	29	2	40	2	28	2	47	1	23	—
	Poplar	166,748	47	6	37	1	28	—	42	1	35	2	26	1
S. District.	St. Saviour, Southwark	27,177	3	—	5	—	3	—	3	1	6	—	3	—
	St. George, Southwark	59,712	25	3	18	—	12	4	28	—	25	2	21	2
	Newington	115,804	35	1	20	3	33	—	33	—	35	2	28	—
	St. Olave, Southwark	12,723	5	—	6	—	1	—	—	—	3	—	2	—
	Bermondsey	84,682	14	—	15	2	14	—	20	—	18	2	11	2
	Rotherhithe	39,235	6	—	2	—	4	1	12	—	9	—	7	—
	Lambeth	275,208	77	3	73	—	70	1	77	2	77	—	54	—
	Battersea	156,558	26	1	33	2	32	1	34	—	41	1	29	1
	Wandsworth	156,942	43	1	47	1	34	1	22	—	32	1	18	—
	Camberwell	235,344	35	—	48	3	46	1	43	1	50	1	40	2
	Greenwich	105,415	30	—	21	1	39	1	40	—	25	1	35	—
	Lewisham	92,617	16	—	23	—	16	—	14	—	21	—	14	—
	Woolwich	46,848	4	—	5	—	7	—	12	—	14	1	8	—
	Plumstead	88,529	15	1	16	—	21	1	20	2	19	1	13	2
	Port of London	—	—	—	—	—	—	—	—	—	—	—	—	—

* Totals of actual *notifications*.

† Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction [illegible]

* Including St. Peters, Westminster (population, 235). † Including Middle Temple (population, 95).

SCARLET FEVER—*continued.*

Weekly Statement, 3rd Quarter, 1893—*continued.*														Totals for 3rd Quarter, 1893.		Sanitary Areas.
Aug. 19.		Aug. 26.		Sept. 2.		Sept. 9.		Sept. 16.		Sept. 23.		Sept. 30.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
790	48	809	32	815	30	1,091	36	1,188	25	1,320	33	1,250	41	13,152	456	London.
772	—	*789*	—	*761*	—	*1,047*	—	*1,189*	—	*1,272*	—	*1,226*	—	*12,718*	—	(*Administrative County.*)
14	—	19	4	22	2	16	2	30	—	28	2	28	3	322	17	Kensington.
10	—	12	—	17	—	19	—	17	—	16	—	16	2	192	5	Fulham.
13	2	7	—	15	—	16	1	8	—	19	—	14	2	222	13	Hammersmith.
14	1	13	—	11	1	15	—	15	—	37	—	21	1	290	8	Paddington.
10	3	8	2	9	2	16	—	23	—	13	—	27	1	186	15	Chelsea.
8	1	20	—	14	—	11	—	15	1	26	—	24	1	233	5	St. George, Hanover Sq.*
5	1	4	—	12	—	17	—	24	3	20	—	8	—	157	9	Westminster.
3	—	2	—	1	—	5	—	9	—	5	—	3	—	44	—	St. James, Westminster.
15	1	16	1	14	—	43	2	22	3	36	—	17	2	315	22	St. Marylebone.
4	1	9	—	5	—	14	—	7	—	21	1	13	—	141	2	Hampstead.
102	4	55	3	45	1	99	5	114	2	119	3	84	2	1,127	41	St. Pancras.
69	5	72	4	77	—	80	3	113	2	117	3	127	2	1,129	25	Islington.
41	—	68	1	54	—	90	3	115	1	72	4	98	4	896	24	Hackney.
4	—	7	—	5	—	10	1	8	—	13	—	9	—	82	2	St. Giles and St. George, Bloomsbury.
1	—	—	—	1	—	2	—	3	—	3	—	2	—	25	1	St. Martin-in-the-Fields.
4	2	5	1	3	1	6	—	3	—	5	1	6	1	63	7	Strand.†
13	—	5	—	5	—	16	—	14	—	5	1	11	—	151	5	Holborn.‡
9	—	22	—	6	—	12	—	22	—	24	—	32	—	255	9	Clerkenwell.
8	3	11	—	5	—	5	—	10	—	9	—	17	1	126	11	St. Luke, Middlesex.
6	1	3	1	17	—	5	—	11	1	9	—	18	—	91	3	London, City of.§
19	—	20	—	32	—	35	2	51	—	29	1	39	—	367	10	Shoreditch.
27	3	43	1	34	2	52	4	60	2	46	1	41	1	564	20	Bethnal Green.
25	2	26	1	30	—	30	2	27	—	19	2	30	1	367	13	Whitechapel.‖
15	—	13	—	15	1	22	1	15	—	29	—	18	—	186	6	St. George-in-the-East.
13	—	19	—	26	—	20	1	15	—	24	—	24	1	208	4	Limehouse.
14	1	28	—	35	—	31	1	32	—	40	—	33	1	413	11	Mile End Old Town.
40	1	37	1	69	6	81	1	78	3	98	2	71	6	689	31	Poplar.
1	—	7	—	3	—	4	1	9	1	4	—	3	1	57	4	St. Saviour, Southwark
20	1	24	3	13	1	12	—	16	1	16	3	15	1	243	21	St. George, Southwark.
30	1	16	—	17	1	22	2	22	1	45	1	45	1	391	13	Newington.
2	—	3	—	1	—	3	—	—	—	1	—	3	—	30	—	St. Olave, Southwark.
7	—	6	—	17	—	18	—	15	—	18	1	14	—	187	7	Bermondsey.
10	—	14	—	12	2	11	1	9	—	6	2	7	—	109	6	Rotherhithe.
48	1	35	1	32	1	59	—	68	—	90	2	83	1	843	12	Lambeth.
31	2	27	1	22	—	28	—	28	2	57	1	48	—	435	12	Battersea.
25	1	29	—	19	1	28	—	33	—	33	—	32	1	395	7	Wandsworth.
38	2	36	4	48	2	43	1	42	—	82	1	66	—	617	18	Camberwell.
24	4	27	1	20	2	45	—	42	1	39	—	47	2	434	13	Greenwich.
15	2	19	1	8	—	20	—	13	—	21	—	21	1	221	4	Lewisham.
6	—	—	—	1	—	7	—	9	—	1	—	8	—	82	1	Woolwich.
27	2	22	1	17	4	23	2	21	1	25	1	27	1	266	19	Plumstead.
—	—	—	—	1	—	—	—	—	—	—	—	—	—	1	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).
§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

Sanitary Areas.	Population (1891).	Scarlet Fever—*continued*. Weekly Statement, 4th Quarter, 1896.											
		Oct. 7.		Oct. 14.		Oct. 21.		Oct. 28.		Nov. 4.		Nov. 11.		Nov. 18.	
		Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
London	4,232,118	1,213	39	1,287	34	1,262	39	1,304	36	1,197	43	1,008	47	988	37
(Administrative County)	—	1,086	—	1,157	—	1,065	—	1,171	—	1,073	—	972	—	925	—
W. District. Kensington	166,868	32	1	34	—	27	1	38	2	26	1	29	2	21	—
W. District. Fulham	91,020	19	—	24	1	14	1	21	1	23	—	17	—	28	—
W. District. Hammersmith	97,239	28	2	25	—	8	1	21	—	18	1	10	—	23	—
W. District. Chelsea	117,806	25	2	21	2	28	1	17	—	22	3	15	2	20	1
W. District. Chiswick	90,253	17	—	12	2	21	—	14	—	12	—	23	—	18	—
W. District. St. George, Hanover Sq.*	78,599	20	1	27	—	21	—	27	—	24	—	6	—	15	—
W. District. Westminster	55,539	14	—	14	1	13	2	7	—	14	1	14	—	10	1
W. District. St. James, Westminster	24,995	4	—	1	—	9	—	2	—	—	—	—	—	1	—
N. District. St. Marylebone	142,404	27	2	39	1	22	3	22	2	24	1	20	2	19	3
N. District. Hampstead	68,426	15	—	15	1	16	1	15	1	19	—	8	1	15	—
N. District. St. Pancras	234,879	62	1	71	2	77	1	88	1	61	1	59	4	72	1
N. District. Islington	315,146	92	5	96	—	95	2	74	—	85	5	78	1	78	1
N. District. Hackney	220,502	82	2	75	2	86	1	89	—	69	—	70	6	81	—
Central District. St. Giles and St. George, Bloomsbury	39,782	11	—	14	1	10	—	6	—	9	1	5	—	6	—
Central District. St. Martin-in-the-Fields	14,616	3	—	4	—	2	—	3	—	4	—	2	—	2	—
Central District. Strand	25,217	3	—	7	—	4	—	1	—	4	1	—	1	3	—
Central District. Holborn‡	34,643	17	—	13	—	5	—	5	—	5	—	7	1	4	1
Central District. Clerkenwell	66,246	28	1	28	2	20	1	22	—	21	2	24	2	21	—
Central District. St. Luke, Middlesex	42,449	7	—	17	—	10	—	12	—	12	—	9	1	7	—
Central District. London, City of§	37,583	5	—	23	—	18	—	9	—	5	—	8	1	8	—
E. District. Shoreditch	124,069	31	1	39	2	31	—	48	2	28	1	27	—	30	1
E. District. Bethnal Green	129,132	42	2	56	—	58	1	52	6	51	2	55	—	46	1
E. District. Whitechapel	74,459	16	1	25	—	21	1	26	—	27	—	20	1	22	2
E. District. St. George-in-the-East	45,795	27	—	30	1	19	—	11	3	16	—	9	—	12	1
E. District. Limehouse	57,377	29	—	30	1	24	1	26	—	24	1	19	5	16	—
E. District. Mile End Old Town	127,592	81	—	25	2	37	2	41	—	23	3	23	—	15	1
E. District. Poplar	166,748	67	2	39	1	33	2	47	1	44	3	47	2	31	1
S. District. St. Saviour, Southwark	27,177	6	—	11	—	7	—	1	—	5	1	3	—	8	—
S. District. St. George, Southwark	59,712	20	—	16	—	22	—	25	1	17	1	20	3	9	1
S. District. Newington	113,894	52	2	58	2	48	3	35	—	45	—	33	1	20	3
S. District. St. Olave, Southwark	12,523	3	—	11	—	6	1	2	—	3	—	6	—	—	—
S. District. Bermondsey	84,182	19	1	17	—	12	—	16	—	15	—	18	—	19	1
S. District. Rotherhithe	39,256	7	1	10	—	14	—	11	—	22	—	11	—	12	1
S. District. Lambeth	275,205	74	1	89	1	87	4	79	4	66	3	58	4	57	1
S. District. Battersea	160,578	60	1	39	1	52	1	58	—	60	1	54	—	39	1
S. District. Wandsworth	155,942	38	4	46	4	57	1	53	2	46	—	34	3	35	4
S. District. Camberwell	240,044	69	2	73	1	87	2	68	2	92	2	64	—	48	3
S. District. Greenwich	100,423	45	3	54	1	64	2	67	5	46	4	46	4	32	6
S. District. Lewisham	99,647	37	—	17	1	23	—	22	—	13	1	11	—	13	1
S. District. Woolwich	46,818	6	—	8	—	13	1	10	—	8	1	15	2	7	—
S. District. Plumstead	88,599	32	1	13	1	14	2	26	—	14	—	10	—	17	1
Port of London	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

* Totals of actual *notifications*.

† Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicate notifications.

‡ Including St. Peters, Westminster (population, 235). § Including Middle Temple (population, 95).

SCARLET FEVER—*continued.*

Weekly Statement, 4th Quarter, 1893—*continued.*											Totals for 4th Quarter, 1893.		Grand Totals for Year 1893.		Sanitary Areas.
Nov. 25.		Dec. 2.		Dec. 9.		Dec. 16.		Dec. 23.		Dec. 30.					
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
739	42	744	34	681	30	564	29	476	32	497	27	11,730	466	37,974	1,587	London.
714	—	*738*	—	*664*	—	*543*	—	*458*	—	*485*	—	*11,409*	—	*36,849*	—	*(Administrative County.)*
19	1	25	—	25	—	15	3	10	—	14	2	315	13	1,015	52	Kensington.
17	2	10	1	14	1	14	—	5	—	22	2	228	9	721	33	Fulham.
14	4	13	—	10	—	16	—	9	—	8	1	203	9	687	36	Hammersmith.
12	1	21	1	17	—	9	1	8	—	8	—	223	14	823	33	Paddington.
10	—	19	1	7	—	9	—	13	—	5	2	180	5	605	32	Chelsea.
10	—	12	1	6	1	9	—	6	—	5	—	188	3	630	25	St. George, Hanover Sq.*
17	—	5	—	13	2	5	—	6	1	2	—	134	8	428	25	Westminster.
7	—	1	—	—	—	1	—	1	—	—	—	27	—	126	2	St. James, Westminster.
20	1	18	2	14	1	17	3	12	1	16	1	274	22	947	68	St. Marylebone.
8	—	14	1	7	—	6	—	5	3	7	—	148	8	540	20	Hampstead.
57	6	36	1	36	2	49	1	30	2	20	1	718	24	2,679	100	St. Pancras.
34	1	37	2	54	3	45	2	45	2	34	3	857	27	3,084	94	Islington.
58	1	75	—	57	3	36	1	34	2	35	3	847	21	2,568	74	Hackney.
3	1	3	—	7	—	1	—	3	—	4	1	82	4	252	14	St. Giles and St. George, Bloomsbury.
1	—	4	—	3	—	—	—	—	—	—	—	28	—	102	2	St. Martin-in-the-Fields.
1	—	1	1	2	—	2	—	—	—	1	—	29	3	140	19	Strand.†
5	—	9	—	2	1	—	—	1	—	3	—	76	3	329	12	Holborn.‡
12	—	12	1	8	1	9	—	7	1	8	—	221	11	774	30	Clerkenwell.
12	1	5	1	7	—	8	1	5	—	1	—	112	4	379	28	St. Luke, Middlesex.
10	—	4	—	5	—	3	—	3	—	5	—	106	1	331	8	London, City of.§
24	—	26	2	11	2	14	1	18	1	15	—	342	13	1,962	39	Shoreditch.
36	3	38	2	37	2	23	2	22	—	31	2	547	23	1,519	71	Bethnal Green.
13	1	14	—	9	1	6	—	6	—	10	—	215	7	863	32	Whitechapel.‖
16	—	14	—	13	—	9	—	2	—	10	—	188	5	519	14	St. George-in-the-East.
18	—	9	1	15	—	8	—	11	—	9	—	237	7	721	35	Limehouse.
24	—	22	—	22	—	17	1	13	1	16	1	319	11	1,203	40	Mile End Old Town.
30	1	29	—	31	1	17	3	23	3	23	—	521	20	1,909	105	Poplar.
7	1	3	—	8	1	3	—	1	1	1	—	70	4	219	18	St. Saviour, Southwark.
5	1	7	—	7	—	4	—	3	—	5	—	160	7	605	42	St. George, Southwark.
17	1	19	2	17	1	15	2	6	1	21	1	406	20	1,133	51	Newington.
8	—	3	—	1	1	2	—	3	—	2	2	50	4	124	6	St. Olave, Southwark.
7	1	13	—	5	1	6	—	6	—	12	—	156	4	574	30	Bermondsey.
6	1	3	—	9	—	4	—	5	2	2	—	116	6	306	16	Rotherhithe.
38	2	33	1	46	—	45	2	33	2	26	1	755	26	2,276	69	Lambeth.
37	1	24	2	30	—	27	—	25	2	31	—	471	10	1,505	40	Battersea.
26	1	34	3	18	1	11	1	23	2	10	—	411	26	1,291	53	Wandsworth.
42	4	47	1	50	1	41	2	27	1	21	2	687	23	1,883	73	Camberwell.
33	3	46	2	28	1	41	2	23	1	38	2	613	36	1,503	71	Greenwich.
10	—	6	—	9	—	5	—	11	—	7	—	190	3	571	11	Lewisham.
1	—	10	1	4	2	6	—	1	1	—	—	84	8	258	16	Woolwich.
14	2	20	4	17	—	6	1	11	2	9	—	196	14	768	48	Plumstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).
§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

Sanitary Areas.	Population (1891).	Diphtheria. Weekly Statement, 1st Quarter, 1893. Jan. 7. Cases.	Jan. 7. Deaths.	Jan. 14. Cases.	Jan. 14. Deaths.	Jan. 21. Cases.	Jan. 21. Deaths.	Jan. 28. Cases.	Jan. 28. Deaths.	Feb. 4. Cases.	Feb. 4. Deaths.	Feb. 11. Cases.	Feb. 11. Deaths.
London	4,232,118	*174	46	131	57	127	37	178	50	175	42	163	40
(*Administrative County*)	-	*164	—	*98	—	*122	—	*170	—	*169	—	*156	—
W. District. Kensington	166,308	2	1	3	—	1	1	2	3	5	1	6	1
W. District. Fulham	91,639	2	—	3	—	—	1	2	1	—	—	1	1
W. District. Hammersmith	97,239	3	1	1	—	—	—	5	—	15	1	1	1
W. District. Paddington	117,846	2	3	3	—	5	—	4	2	7	—	6	1
W. District. Chelsea	96,253	2	—	2	—	5	1	1	1	6	1	7	2
W. District. St. George, Hanover Sq.*	78,509	2	—	3	2	2	—	—	—	1	1	3	1
W. District. Westminster	55,539	1	1	2	—	1	—	2	—	1	—	3	—
W. District. St. James, Westminster	24,995	—	—	—	—	—	—	—	—	1	—	1	—
N. District. St. Marylebone	142,404	3	1	—	2	—	1	4	1	5	—	3	—
N. District. Hampstead	68,416	—	—	1	—	1	—	3	1	2	3	6	2
N. District. St Pancras	234,379	10	1	15	7	4	4	17	2	10	6	9	4
N. District. Islington	319,143	12	2	11	4	13	3	10	4	8	—	13	2
N. District. Hackney	229,542	14	3	5	4	10	2	17	7	16	3	14	6
Central District. St. Giles and St. George, Bloomsbury.	39,782	7	3	2	1	—	—	—	—	—	—	1	—
Central District. St. Martin-in-the-Fields	14,616	—	—	—	—	—	—	—	—	—	—	—	—
Central District. Strand†	25,217	2	1	1	—	4	—	1	—	2	1	—	—
Central District. Holborn‡	34,043	1	—	1	—	—	—	2	1	1	—	1	—
Central District. Clerkenwell	66,216	3	2	—	—	5	1	5	2	—	—	3	—
Central District. St. Luke, Middlesex	42,440	1	—	—	—	—	1	1	—	1	1	1	—
Central District. London, City of§	37,583	2	—	—	—	—	—	—	—	6	—	1	—
E. District. Shoreditch	124,909	3	1	2	—	4	1	10	3	3	3	5	1
E. District. Bethnal Green	129,132	9	1	14	6	10	4	13	1	6	—	11	4
E. District. Whitechapel	74,420	4	2	2	1	3	—	3	3	4	—	1	—
E. District. St. George-in-the-East	45,705	3	1	3	1	7	2	2	1	8	4	8	2
E. District. Limehouse	57,376	3	1	1	3	2	—	4	1	5	1	4	2
E. District. Mile End Old Town	107,592	4	—	1	1	2	1	9	2	3	4	4	1
E. District. Poplar	166,748	8	—	6	2	3	—	8	1	6	—	4	2
S. District. St. Saviour, Southwark	27,177	2	—	—	—	1	—	1	—	—	—	2	—
S. District. St. George, Southwark	50,712	—	—	2	2	—	—	2	—	1	—	3	—
S. District. Newington	111,804	1	—	3	—	3	1	4	—	3	1	5	3
S. District. St. Olave, Southwark	12,723	—	—	—	—	—	—	—	—	—	—	—	—
S. District. Bermondsey	84,082	1	—	2	2	3	1	2	2	6	—	—	3
S. District. Rotherhithe	32,955	—	—	1	1	—	—	3	1	1	1	—	1
S. District. Lambeth	274,203	18	3	9	4	13	7	7	2	5	1	11	3
S. District. Battersea	156,558	14	6	6	4	7	2	7	1	9	4	3	1
S. District. Wandsworth	156,042	8	—	6	1	6	—	4	1	6	2	9	1
S. District. Camberwell	283,344	2	2	4	—	3	—	10	2	5	—	5	2
S. District. Greenwich	163,113	5	4	5	2	2	—	4	—	8	2	3	2
S. District. Lewisham	92,647	11	2	5	3	1	—	1	—	1	1	2	1
S. District. Woolwich	40,848	1	—	—	1	—	—	1	—	—	—	—	—
S. District. Plumstead	88,239	9	4	6	3	6	3	7	5	3	—	1	3
S. District. Port of London	—	—	—	—	—	—	—	—	—	—	—	—	—

* Totals of actual *and fictitious* cases.

† Cases transmitted by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicate notifications.

* Including St. Peters, Westminster (population, 235). † Including Middle Temple (population, 93).

DIPHTHERIA—*continued*.

Weekly Statement, 1st Quarter, 1893—*continued*.														Totals for 1st Quarter, 1893.		Sanitary Areas.
Feb. 18.		Feb. 25.		March 4.		March 11.		March 18.		March 25.		April 1.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
180	60	182	49	139	36	175	38	164	65	172	49	134	34	2,094	623	London.
169	—	*176*	—	*135*	—	*164*	—	*160*	—	*163*	—	*126*	—	*2,098*	—	(*Administrative County.*)
—	—	6	—	3	2	8	2	2	3	3	1	4	—	45	15	Kensington.
2	2	—	—	2	—	2	—	4	1	2	—	1	1	21	7	Fulham.
4	1	5	1	3	1	5	2	1	—	1	—	2	—	46	8	Hammersmith.
3	4	3	1	2	—	5	1	3	—	7	1	1	2	51	15	Paddington.
4	2	4	1	—	—	8	1	3	1	1	1	2	—	45	11	Chelsea.
2	1	—	2	1	—	—	—	1	1	1	—	1	—	17	8	St. George, Hanover Sq.*
2	—	1	—	1	—	—	—	—	—	1	—	4	—	19	1	Westminster.
—	1	1	—	—	—	3	1	—	—	—	—	—	—	6	2	St. James, Westminster.
3	1	3	—	3	3	5	—	7	3	4	1	4	—	44	13	St. Marylebone.
2	—	3	1	3	1	3	2	4	—	7	3	5	3	40	16	Hampstead.
16	6	16	7	7	5	13	1	16	3	17	1	11	4	161	51	St. Pancras.
18	5	9	2	7	1	14	3	10	5	10	—	9	1	144	32	Islington.
12	5	10	3	13	4	6	1	13	4	13	4	4	—	147	46	Hackney.
—	—	2	—	1	1	1	—	—	—	—	—	1	—	15	5	St. Giles and St. George, Bloomsbury.
1	—	—	—	—	—	4	—	—	1	1	1	—	—	6	2	St. Martin-in-the-Fields.
1	—	—	—	—	—	—	—	—	—	—	—	—	1	11	3	Strand.†
1	—	—	—	—	—	1	1	1	—	—	1	1	—	10	3	Holborn.‡
2	1	—	—	4	—	7	—	4	4	6	—	4	—	43	10	Clerkenwell.
—	2	3	—	2	1	1	—	3	1	2	—	1	—	16	6	St. Lukes, Middlesex.
1	—	1	—	2	—	—	—	—	—	1	—	—	1	14	1	London, City of.§
7	—	7	3	4	1	5	1	5	4	5	3	3	1	62	22	Shoreditch.
4	3	9	1	10	2	10	4	6	2	5	1	13	5	120	34	Bethnal Green.
7	1	5	2	1	—	—	—	3	1	1	2	2	1	36	12	Whitechapel.‖
4	4	1	2	4	1	8	3	4	1	1	1	3	2	51	25	St. George-in-the-East.
3	—	1	—	5	1	8	1	—	1	3	—	3	1	37	12	Limehouse.
7	3	9	1	10	—	4	—	7	3	8	3	6	1	74	20	Mile End Old Town.
17	2	32	6	15	8	13	1	13	3	16	7	17	—	158	32	Poplar.
2	2	—	—	1	—	1	1	2	1	3	1	1	—	16	5	St. Saviour, Southwark.
4	1	—	1	2	1	4	1	—	—	1	—	2	1	21	7	St. George, Southwark.
10	4	4	3	3	—	3	—	10	2	9	2	5	—	68	16	Newington.
—	—	1	—	—	—	—	—	1	—	—	—	2	—	4	—	St. Olave, Southwark.
2	1	1	—	1	1	2	1	3	3	2	2	1	—	26	18	Bermondsey.
—	—	1	1	1	—	1	1	—	—	1	—	—	—	9	6	Rotherhithe.
13	2	17	6	7	1	13	2	7	5	7	4	4	1	131	46	Lambeth.
8	—	8	—	4	—	1	1	13	3	10	3	4	1	94	26	Battersea.
2	—	3	—	2	—	4	1	2	—	3	1	2	2	57	9	Wandsworth.
4	2	6	—	6	—	3	2	5	1	4	1	3	2	60	14	Camberwell.
4	2	6	1	4	1	8	1	1	4	5	1	2	1	56	21	Greenwich.
2	—	1	1	2	—	6	1	5	2	4	—	3	—	47	11	Lewisham.
—	—	—	—	1	—	—	—	2	1	—	1	—	—	5	3	Woolwich.
6	2	3	3	2	—	5	1	3	1	7	2	3	2	61	29	Plumstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).
§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868.)

DIPHTHERIA—continued.

Sanitary Areas.	Population (1891).	Weekly Statement, 2nd Quarter, 1893. April 8.		April 15.		April 22.		April 29.		May 6.		May 13.	
		Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
London	4,232,118	*173	38	144	44	185	42	147	48	220	52	233	65
(*Administrative County*)		*169	—	136	—	182	—	142	—	221	—	226	—
W. District. Kensington	166,308	2	—	2	—	1	—	8	1	2	1	5	1
W. District. Fulham	91,939	1	—	2	—	—	1	2	—	3	1	2	2
W. District. Hammersmith	97,339	3	—	2	—	1	—	2	1	5	—	1	1
W. District. Paddington	117,846	6	1	7	1	7	1	8	4	5	2	2	1
W. District. Chelsea	96,253	4	—	4	1	1	1	3	1	2	—	6	—
W. District. St. George, Hanover Sq.*	78,590	2	1	1	—	1	—	2	—	—	1	1	—
W. District. Westminster	55,539	—	—	—	—	—	—		1	3	1	3	1
W. District. St. James, Westminster	24,995	—	—	—	1	—	—	7	—	1	—	—	—
N. District. St. Marylebone	142,491	5	3	7	—	5	3	8	6	16	2	16	7
N. District. Hampstead	68,416	2	—	1	—	2	1	5	—	9	2	5	—
N. District. St. Pancras	234,379	17	7	7	2	11	2	7	2	14	3	13	2
N. District. Islington	319,443	14	4	16	1	11	6	12	5	14	1	15	2
N. District. Hackney	220,542	9	2	8	2	12	1	10	2	11	4	24	8
Central District. St. Giles and St. George, Bloomsbury.	39,782	—	—	2	—	1	1	2	—	2	1	2	1
Central District. St. Martin-in-the-Fields	14,616	—	—	1	—	—	—	1	—	1	1	1	—
Central District. Strand†	25,217	1	1	1	1	2	—	3	1	3	—	2	—
Central District. Holborn‡	34,043	5	—	—	2	—	—			—	—	—	—
Central District. Clerkenwell	66,216	4	1	3	4	3	—	10	2	7	4	14	5
Central District. St. Luke, Middlesex	42,440	1	—	1	—	1	—	1	—	2	—	2	2
Central District. London, City of§	37,583	2	—	1	—	3	—	2	—	—	1	2	—
E. District. Shoreditch	124,009	5	3	7	3	8	—	11	5	9	3	9	1
E. District. Bethnal Green	129,132	10	2	10	—	10	—	12	2	6	—	16	2
E. District. Whitechapel	74,420	2	—	3	1	2	1	4	—	4	1	1	—
E. District. St. George-in-the-East	45,795	4	1	4	2	4	2	2	1	7	1	3	1
E. District. Limehouse	57,376	1	1	—	—	5	2	4	—	5	1	4	2
E. District. Mile End Old Town	107,972	7	1	8	—	4	2	1	1	2	—	5	4
E. District. Poplar	160,748	16	—	8	5	8	2	28	1	22	8	26	3
S. District. St. Saviour, Southwark	27,177	1	—	—	—	—	—	2	—	3	—	—	—
S. District. St. George, Southwark	59,712	1	—	—	1	4	—	5	1	3	1	1	1
S. District. Newington	115,894	7	—	1	1	8	5	5	—	5	1	1	2
S. District. St. Olave, Southwark	12,703	—	—	—	1	—	—		—	—	—	—	—
S. District. Bermondsey	84,682	—	1	1	1	3	1	1	—	1	—	5	2
S. District. Rotherhithe	39,295	2	—	3	1	—	—	—	—	5	2	3	—
S. District. Lambeth	275,293	8	1	7	1	9	2	9	2	17	2	20	8
S. District. Battersea	159,368	6	2	5	1	11	1	5	1	15	3	7	3
S. District. Wandsworth	156,912	4	2	2	1	1	—	4	—	8	1	3	1
S. District. Camberwell	245,344	5	1	3	1	4	2	2	—	9	—	6	1
S. District. Greenwich	165,413	6	1	5	4	8	1	6	3	4	—	1	1
S. District. Lewisham	92,647	1	—	6	3	4	—	1	1	4	2	4	—
S. District. Woolwich	40,848	2	—	—	—	—	—	1	—	—	1	—	—
S. District. Plumstead	88,539	7	2	5	2	10	4	1	1	—	—	2	—
S. District. Port of London	—	—	—	—	—	—	—	—	—				

* Totals of actual *notifications*.

† Totals corrected by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicate notifications.

‡ Including St. Peters, Westminster (population, 235). § Including Middle Temple (population, 95).

DIPHTHERIA—*continued.*

Weekly Statement, 2nd Quarter, 1893—*continued.*														Totals for 2nd Quarter, 1893.		Sanitary Areas.
May 20.		May 27.		June 3.		June 10.		June 17.		June 24.		July 1.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
214	49	217	41	191	51	257	39	306	61	313	67	300	63	2,934	660	London.
210	—	*206*	—	*184*	—	*251*	—	*294*	—	*305*	—	*293*	—	*2,843*	—	(*Administrative County.*)
12	1	5	—	12	2	7	2	2	2	7	—	10	4	75	14	Kensington.
2	—	1	—	8	3	2	4	5	—	2	—	5	3	35	14	Fulham.
7	1	8	1	5	—	3	—	4	1	15	—	20	1	76	6	Hammersmith.
4	—	6	1	6	2	5	—	3	1	5	—	4	1	68	15	Paddington.
2	1	3	1	—	—	2	—	5	1	2	1	6	1	40	8	Chelsea.
2	—	1	—	1	2	2	1	7	—	2	4	7	1	29	10	St. George, Hanover Sq.*
3	2	1	—	—	—	2	—	1	—	—	—	—	—	13	5	Westminster.
3	1	1	—	—	1	1	—	—	—	2	—	4	—	19	3	St. James, Westminster.
7	4	8	1	11	1	12	—	10	2	11	1	7	2	123	32	St. Marylebone.
6	2	11	2	5	3	—	1	6	1	1	—	2	1	55	13	Hampstead.
12	4	12	2	5	3	16	2	27	6	21	2	5	5	165	42	St. Pancras.
13	5	10	3	17	6	21	2	9	—	27	3	22	7	201	45	Islington.
20	2	16	1	13	4	16	5	16	1	12	—	13	3	180	35	Hackney.
2	1	1	—	—	—	—	—	2	—	1	—	4	1	19	5	St. Giles and St. George, Bloomsbury.
—	—	1	—	—	—	2	—	—	—	—	—	—	—	7	1	St. Martin-in-the-Fields.
2	—	5	2	1	—	5	—	3	1	1	—	1	1	30	7	Strand.†
3	—	4	3	5	2	6	—	1	1	1	—	6	1	31	9	Holborn.‡
8	3	5	1	2	1	10	1	11	2	3	2	4	—	84	26	Clerkenwell.
2	—	4	—	3	2	2	1	4	—	3	1	2	1	28	7	St. Luke, Middlesex.
3	—	1	—	—	—	1	—	4	—	3	1	2	—	24	2	London, City of.§
8	1	12	3	5	2	6	3	17	5	8	3	13	1	118	33	Shoreditch.
8	1	14	1	11	2	15	—	17	4	15	3	24	2	168	19	Bethnal Green.
7	2	2	3	1	1	5	—	5	3	3	1	5	—	44	13	Whitechapel.‖
4	—	9	2	8	2	7	—	8	5	9	1	4	—	73	18	St. George-in-the-East.
3	2	4	2	2	—	5	1	4	—	6	3	—	—	43	14	Limehouse.
6	1	5	1	12	2	6	2	12	4	9	6	9	2	86	26	Mile End Old Town.
15	2	8	—	9	—	18	—	48	6	48	9	29	7	283	43	Poplar.
—	1	2	—	—	—	3	—	3	—	2	—	1	—	17	1	St. Saviour, Southwark.
—	—	3	—	—	—	1	—	5	—	7	—	4	—	34	4	St. George, Southwark.
4	—	7	1	5	—	12	2	6	1	9	1	13	2	83	16	Newington.
—	—	—	—	2	1	—	—	1	—	1	—	—	—	4	2	St. Olave, Southwark.
9	2	3	1	3	3	8	4	2	1	5	3	12	2	53	21	Bermondsey.
2	—	4	—	2	—	2	—	2	—	2	1	4	—	31	4	Rotherhithe.
11	2	13	3	13	—	12	2	14	—	16	3	18	2	167	28	Lambeth.
9	1	8	4	10	4	14	1	11	2	23	7	11	2	135	35	Battersea.
2	1	6	—	2	—	5	1	7	2	6	3	9	4	59	16	Wandsworth.
5	—	5	1	4	1	13	3	7	2	9	4	9	1	81	17	Camberwell.
5	3	2	1	6	1	9	—	9	4	7	—	6	3	71	22	Greenwich.
1	2	3	—	2	—	—	—	6	2	3	2	2	—	37	12	Lewisham.
—	—	1	—	—	—	—	—	—	—	1	—	—	1	5	2	Woolwich.
2	1	2	—	—	—	1	1	2	1	5	2	3	1	40	15	Plumstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).
§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

Sanitary Areas.	Population (1891).	Diphtheria—continued. Weekly Statement, 3rd Quarter, 1893											
		July 8.		July 15.		July 22.		July 29.		Aug. 5.		Aug. 12.	
		Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
London	4,203,118	*282	51	266	62	285	65	272	71	242	64	232	46
(Administrative County)	—	276	—	257	—	272	—	264	—	241	—	224	—
W. District. Kensington	166,208	3	1	17	5	17	3	14	3	10	3	8	6
Fulham	91,639	3	1	2	2	1	—	—	2	4	1	2	—
Hammersmith	97,239	6	—	10	3	8	4	5	—	7	6	1	—
Paddington	117,846	6	1	10	—	4	3	6	1	6	—	1	—
Chelsea	98,033	6	1	4	—	4	1	6	4	6	1	6	1
St. George, Hanover Sq.*	78,330	3	—	3	—	3	—	3	3	7	3	2	1
Westminster	56,539	6	2	3	—	4	1	1	—	—	—	1	—
St. James, Westminster	24,695	1	—	—	1	1	—	1	1	1	—	2	—
N. District. St. Marylebone	142,164	10	—	3	1	8	—	8	1	6	—	4	1
Hampstead	68,427	—	—	1	1	1	—	2	1	2	1	2	—
St. Pancras	230,170	20	8	14	2	21	6	21	5	17	4	17	5
Islington	313,143	17	2	17	2	12	3	13	6	16	3	20	3
Hackney	229,542	8	—	12	2	9	2	16	4	20	6	14	4
Central District. St. Giles and St. George, Bloomsbury	39,782	3	—	4	—	1	2	1	—	—	1	2	—
St. Martin-in-the-Fields	14,686	—	—	—	—	—	—	1	1	—	—	—	—
Strand	25,917	—	—	4	1	1	—	1	2	4	—	3	1
Holborn†	31,843	1	—	2	1	3	—	2	2	1	—	—	—
Clerkenwell	66,276	11	—	7	2	4	1	3	2	4	—	4	—
St. Luke, Middlesex	42,402	6	—	1	2	4	3	3	—	7	—	6	2
London, City of‡	37,583	—	1	—	—	2	2	4	—	2	1	—	—
E. District. Shoreditch	124,699	14	2	9	6	12	5	16	5	18	6	14	5
Bethnal Green	129,102	20	2	15	2	18	3	20	3	22	5	12	4
Whitechapel	74,420	6	—	7	—	6	1	5	2	2	2	3	1
St. George-in-the-East	42,755	7	2	9	—	4	—	2	1	5	—	2	2
Limehouse	57,891	7	2	3	—	2	1	7	1	2	3	9	3
Mile End Old Town	127,699	6	1	14	1	3	2	10	2	4	3	6	—
Poplar	166,744	21	4	33	6	30	2	28	9	19	4	15	3
S. District. St. Saviour, Southwark	27,177	3	—	1	—	2	—	1	—	1	2	5	—
St. George, Southwark	50,712	2	1	—	1	4	1	3	—	7	—	6	2
Newington	113,851	9	2	5	2	13	1	14	—	6	—	10	1
St. Olave, Southwark	12,756	—	—	—	—	—	—	—	—	—	—	—	—
Bermondsey	84,289	2	1	3	—	5	1	1	—	2	—	6	1
Rotherhithe	36,035	6	1	1	—	2	1	1	1	2	—	2	—
Lambeth	277,991	20	4	23	2	15	6	5	4	16	3	10	4
Battersea	168,955	12	2	15	2	9	4	10	4	10	3	8	4
Wandsworth	249,993	5	—	10	1	12	4	17	3	14	4	10	3
Camberwell	288,344	13	3	3	2	10	—	7	1	5	2	6	1
Greenwich	129,476	7	1	14	1	12	1	13	3	10	2	7	2
Lewisham	89,647	2	—	4	—	1	—	3	—	3	—	4	—
Woolwich	109,928	—	—	—	—	1	—	—	—	—	—	—	—
Plumstead	54,999	3	1	2	1	3	1	2	1	3	1	3	—
Port of London	—	—	—	—	—	—	—	—	—	—	—	—	—

* [illegible] of Hanover Square.

† [illegible] Inner Temple and the Metropolitan Asylums Board [illegible] cases admitted to [illegible] Hospitals and Districts of dangerous infectiousness.

‡ Including St. Peters, Westminster (population, 333). † Including Middle Temple (population, 26).

DIPHTHERIA—*continued.*

Weekly Statement, 3rd Quarter, 1893—*continued.*														Totals for 3rd Quarter, 1893.		Sanitary Areas.
Aug. 19.		Aug. 26.		Sept. 2.		Sept. 9.		Sept. 16.		Sept. 23.		Sept. 30.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
292	63	269	55	271	54	322	64	351	64	448	86	411	94	4,070	848	London.
276	—	*253*	—	*247*	—	*312*	—	*339*	—	*436*	—	*396*	—	*3,917*	—	(*Administrative County.*)
8	1	7	1	7	1	5	1	13	3	8	2	3	1	117	26	Kensington.
2	1	—	2	5	3	4	1	9	—	8	1	16	1	61	15	Fulham.
1	3	12	3	6	1	4	1	—	1	9	2	9	3	87	24	Hammersmith.
4	—	3	—	3	1	5	2	7	1	6	4	3	1	67	14	Paddington.
2	—	5	—	7	—	3	2	2	1	5	—	2	—	58	11	Chelsea.
3	—	—	—	6	—	4	—	2	—	4	1	2	—	44	8	St. George, Hanover Sq.*
1	—	1	—	1	—	2	—	3	—	—	—	—	—	23	3	Westminster.
—	1	1	—	2	2	—	—	2	—	—	—	—	—	11	6	St. James, Westminster.
11	2	6	1	5	1	7	1	12	2	15	3	13	4	105	17	St. Marylebone.
4	—	3	1	3	—	2	—	—	—	3	—	4	—	34	4	Hampstead.
23	4	19	3	7	4	24	4	16	1	22	3	18	6	241	53	St. Pancras.
20	6	25	5	13	2	19	9	31	5	19	3	26	4	249	53	Islington.
12	1	21	4	18	1	26	4	30	5	32	8	35	3	253	44	Hackney.
2	1	—	—	4	—	—	—	1	—	3	—	—	1	21	5	St. Giles and St. George, Bloomsbury.
—	—	—	—	1	—	—	—	—	—	2	1	—	—	4	2	St. Martin-in-the-Fields.
—	1	1	—	1	—	—	—	—	—	1	—	3	—	19	5	Strand.†
—	—	—	—	2	—	4	1	5	—	3	1	5	1	28	6	Holborn.‡
4	1	13	2	8	—	5	3	9	1	3	2	14	4	93	18	Clerkenwell.
6	2	5	—	2	1	7	3	11	1	8	1	4	1	70	16	St. Luke, Middlesex.
—	—	—	—	3	—	2	—	—	—	—	—	—	1	13	5	London, City of.§
18	2	7	—	9	2	16	2	20	2	18	3	16	3	182	40	Shoreditch.
25	2	12	—	7	1	25	4	21	6	31	4	16	2	244	39	Bethnal Green.
4	2	10	1	9	2	2	3	9	2	5	3	8	3	80	22	Whitechapel.‖
2	2	1	—	4	1	5	—	3	—	12	—	12	—	75	8	St. George-in-the-East.
9	3	11	4	15	3	6	2	5	1	13	—	6	—	98	21	Limehouse.
10	1	6	1	7	1	7	—	4	—	20	3	6	1	103	15	Mile End Old Town.
24	4	17	4	29	4	47	3	35	5	57	7	40	8	390	57	Poplar.
3	—	—	—	4	1	—	—	2	1	2	—	3	3	28	7	St. Saviour, Southwark.
16	2	6	1	11	—	9	—	2	3	7	4	7	2	79	16	St. George, Southwark.
19	3	12	5	19	3	16	3	11	3	18	1	14	2	166	29	Newington.
—	—	—	1	2	—	—	—	—	—	—	—	2	—	4	1	St. Olave, Southwark.
2	—	7	—	5	4	2	1	3	—	4	1	7	3	54	14	Bermondsey.
6	2	2	1	3	—	1	—	2	—	1	2	2	—	36	11	Rotherhithe.
16	—	22	2	8	—	19	6	28	3	30	6	19	5	250	44	Lambeth.
6	1	4	2	9	3	15	2	16	5	20	8	29	11	182	45	Battersea.
6	4	16	5	8	7	12	1	15	5	20	6	14	1	151	47	Wandsworth.
5	4	6	4	6	—	3	2	9	1	8	2	17	2	109	28	Camberwell.
6	2	1	2	7	2	8	1	7	5	19	3	29	15	145	45	Greenwich.
7	2	4	—	4	3	3	1	1	1	5	1	3	—	40	12	Lewisham.
1	—	—	—	1	—	1	—	1	—	1	—	—	—	6	—	Woolwich.
4	3	3	—	—	—	2	1	4	—	6	—	4	2	50	12	Plumstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

Sanitary Areas.	Population (1891).	Diphtheria - *continued.* Weekly Statement, 4th Quarter, 1893.													
		Oct. 7.		Oct. 14.		Oct. 21.		Oct. 28.		Nov. 4.		Nov. 11.		Nov. 18.	
		Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
London	4,232,118	436	72	389	84	400	82	339	81	385	87	314	98	357	89
(*Administrative County*)		326		296		302		246	—	267		207	—	246	—
W. District. Kensington	166,308	3	—	24	2	12	5	9	2	15	5	9	—	9	1
Fulham	91,039	18	1	10	1	10	2	7	1	7	2	7	2	10	2
Hammersmith	97,239	15	2	1	1	9	—	8	1	2	1	3	1	6	—
Paddington	117,846	11	3	8	2	12	1	11	5	5	2	8	2	13	1
Chelsea	96,253	13	1	3	1	8	3	7	5	9	—	8	2	12	2
St. George, Hanover Sq.*	78,599	1	—	2	1	2	—	2	—	1	1	2	—	5	2
Westminster	55,539	2	—	3	1	2	1	—	—	5	—	6	1	1	1
St. James, Westminster	24,995	1	—	1	—	1	—	2	1	2	—	1	—	—	—
N. District. St. Marylebone	142,404	12	4	17	4	4	1	4	1	11	3	11	9	11	—
Hampstead	68,446	5	2	5	—	1	1	5	—	5	—	—	—	2	—
St. Pancras	234,379	25	3	18	5	25	7	15	7	28	7	8	3	23	6
Islington	319,143	24	4	24	3	25	5	24	4	18	3	22	3	31	10
Hackney	229,542	38	4	32	5	41	10	32	5	27	5	30	10	24	3
Central District. St. Giles and St. George, Bloomsbury.	39,782	1	1	10	1	3	—	1	—	6	1	3	2	—	1
St. Martin-in-the-Fields	14,616	—	—	1	—	—	—	1	—	1	1	1	—	1	—
Strand†	25,217	1	1	—	—	—	—	3	2	4	—	2	—	1	—
Holborn‡	34,043	3	—	2	1	4	—	4	—	2	—	4	2	3	—
Clerkenwell	68,216	18	3	11	4	3	2	3	—	11	1	7	2	13	3
St. Luke, Middlesex	42,430	5	1	5	—	5	3	6	2	3	2	—	2	3	—
London, City of§	37,583	1	—	1	—	2	—	6	1	1	2	—	—	1	—
E. District. Shoreditch	124,009	17	4	21	1	21	2	9	6	4	5	8	2	15	3
Bethnal Green	129,132	22	7	23	3	11	—	14	3	22	3	15	4	17	6
Whitechapel‖	74,420	3	—	8	2	3	—	3	1	3	—	5	—	8	1
St. George-in-the-East	45,795	9	1	1	1	7	1	5	2	9	—	3	1	1	—
Limehouse	57,376	10	3	2	1	10	1	5	1	3	1	2	—	6	1
Mile End Old Town	107,592	5	1	8	1	5	—	5	1	6	1	5	1	10	4
Poplar	168,748	39	2	27	5	17	2	34	1	22	3	21	6	15	1
S. District. St. Saviour, Southwark	27,177	4	—	2	1	1	—	4	—	3	—	1	2	—	—
St. George, Southwark	50,712	4	—	1	3	8	3	2	2	7	—	3	—	7	1
Newington	115,804	19	1	16	5	13	1	17	2	16	3	9	4	14	2
St. Olave, Southwark	12,726	1	—	1	—	1	—	—	—	2	1	3	—	4	—
Bermondsey	84,987	7	—	4	1	7	3	11	2	9	2	5	5	7	4
Rotherhithe	39,855	4	1	—	2	—	—	4	1	5	—	—	1	4	2
Lambeth	277,998	20	1	26	4	31	6	15	3	25	19	20	4	20	9
Battersea	159,738	17	2	14	5	21	8	20	5	36	7	15	6	7	6
Wandsworth	156,949	7	5	10	6	13	3	18	2	8	3	22	6	10	4
Camberwell	237,544	21	4	16	2	19	4	22	1	16	4	24	6	15	5
Greenwich	165,413	14	7	10	3	20	3	15	5	16	3	10	7	13	2
Lewisham	92,647	6	—	6	2	17	1	4	3	8	4	4	1	3	—
Woolwich	103,848	—	—	—	—	—	—	—	—	—	—	2	—	—	1
Plumstead	88,739	10	3	6	2	6	3	2	3	2	1	6	2	4	1
Port of London	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

* Totals of actual [illegible]

† Totals [illegible] the Metropolitan Asylums Board of *actual cases* after correction of returns and reduction of duplicate notifications.

‡ Including St. Peters, Westminster (population, 235).

† Including Middle Temple (population, 95).

DIPHTHERIA—*continued.*

Weekly Statement, 4th Quarter, 1893—*continued.*												Totals for 4th Quarter, 1893.		Grand Totals for Year 1893.		Sanitary Areas.
Nov. 25.		Dec. 2.		Dec. 9.		Dec. 16.		Dec. 23.		Dec. 30.						
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
365	89	297	72	274	86	301	85	255	61	240	79	4,372	1,065	13,470	3,196	London.
355	—	*293*	—	*260*	—	*293*	—	*244*	—	*229*	—	*4,245*	—	*13,013*	—	(*Administrative County.*)
9	2	21	1	14	2	8	6	7	1	7	1	147	28	384	83	Kensington.
13	2	12	3	8	3	9	4	3	2	9	3	123	28	240	64	Fulham.
5	1	8	1	1	3	6	3	3	—	3	1	70	15	279	53	Hammersmith.
3	3	8	—	6	4	4	—	11	2	3	1	103	26	289	70	Paddington.
8	3	5	2	6	—	6	1	3	—	5	2	93	22	236	52	Chelsea.
2	—	1	—	3	—	4	1	7	1	—	2	32	8	122	34	St. George, Hanover Sq.*
3	—	2	—	1	—	2	1	1	—	2	—	30	5	85	14	Westminster.
1	—	—	1	—	—	2	1	1	—	1	—	13	3	49	14	St. James, Westminster.
12	3	7	3	6	2	11	—	10	1	6	1	122	32	394	94	St. Marylebone.
1	—	6	—	—	1	3	—	—	—	2	1	35	5	164	38	Hampstead.
19	—	15	2	12	4	18	3	13	2	4	6	223	55	790	201	St. Pancras.
35	2	21	5	21	9	22	7	20	3	23	12	310	70	904	200	Islington.
28	7	12	7	17	2	22	9	27	5	21	9	351	81	931	206	Hackney.
—	—	—	—	—	—	—	—	—	—	2	1	26	7	81	22	St. Giles and St. George, Bloomsbury.
1	1	—	—	1	1	—	—	—	—	—	—	7	3	24	8	St. Martin-in-the-Fields.
2	—	—	1	2	—	1	3	1	—	2	—	19	7	79	22	Strand.†
3	—	1	—	1	—	2	—	2	—	5	1	36	4	105	22	Holborn.‡
2	2	2	1	4	—	9	1	4	1	—	2	87	22	307	76	Clerkenwell.
6	2	4	1	—	2	2	—	1	—	6	2	46	17	160	46	St. Luke, Middlesex.
1	—	1	—	1	—	2	—	—	—	2	—	19	3	70	11	London, City of.§
7	4	9	3	17	4	11	4	7	3	3	1	149	42	511	137	Shoreditch.
12	6	8	3	8	1	13	3	10	2	16	3	191	44	723	136	Bethnal Green.
6	2	4	3	3	2	4	3	3	—	2	—	55	14	215	61	Whitechapel.‖
1	1	1	—	3	1	—	—	6	2	5	1	51	11	250	62	St. George-in-the-East.
5	2	7	—	3	1	2	2	1	—	3	1	59	14	237	61	Limehouse.
7	5	9	1	9	1	9	2	6	—	5	1	89	19	352	80	Mile End Old Town.
15	1	17	2	13	6	18	3	23	2	19	2	280	36	1,111	168	Poplar.
2	—	—	—	4	1	2	1	1	—	1	—	26	4	87	17	St. Saviour, Southwark.
6	3	5	2	3	—	3	2	1	—	—	2	50	18	184	45	St. George, Southwark.
10	4	7	2	13	2	8	2	6	3	8	1	156	32	473	93	Newington.
2	1	3	—	2	1	2	—	2	1	—	—	23	4	35	7	St. Olave, Southwark.
4	2	6	—	4	2	3	2	4	3	5	1	76	27	209	80	Bermondsey.
3	3	2	—	1	—	1	—	1	—	2	1	27	10	103	31	Rotherhithe.
19	5	19	3	20	7	21	6	12	5	8	3	256	66	804	184	Lambeth.
26	4	15	5	19	4	22	3	16	5	10	1	238	61	649	167	Battersea.
14	3	7	3	4	1	14	3	7	2	9	1	143	42	410	114	Wandsworth.
35	10	32	10	13	6	12	5	10	4	11	6	250	71	500	130	Camberwell.
26	5	18	6	17	8	12	—	13	5	14	3	207	59	479	147	Greenwich.
4	—	2	1	6	2	5	—	5	2	6	2	78	18	202	53	Lewisham.
2	—	—	—	1	—	1	1	1	1	3	—	10	3	26	8	Woolwich.
5	1	—	—	7	3	5	3	6	3	7	4	66	29	217	85	Plumstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Port of London.

‡ Including Gray's Inn (population 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).
§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

	Sanitary Areas.	Population (1891).	Enteric Fever. Weekly Statement, 1st Quarter, 1893. Jan. 7. Cases.	Jan. 7. Deaths.	Jan. 14. Cases.	Jan. 14. Deaths.	Jan. 21. Cases.	Jan. 21. Deaths.	Jan. 28. Cases.	Jan. 28. Deaths.	Feb. 4. Cases.	Feb. 4. Deaths.	Feb. 11. Cases.	Feb. 11. Deaths.
	London	4,232,118	[a]48	11	57	10	49	7	47	4	41	9	47	4
	(*Administrative County*)	-	[b]47	—	57	—	49	—	44	—	30	—	45	—
W. District.	Kensington	166,308	2	—	3	—	1	1	—	—	2	—	2	—
	Fulham	91,639	1	1	—	—	—	—	—	—	1	—	—	—
	Hammersmith	97,239	2	—	2	—	3	—	2	—	—	—	3	—
	Paddington	117,846	1	1	—	—	1	—	1	—	—	—	—	—
	Chelsea	96,253	2	1	2	1	2	—	1	—	1	—	5	1
	St. George, Hanover Sq.*	78,590	1	—	5	—	1	—	—	1	—	—	1	—
	Westminster	55,539	—	1	1	—	—	—	—	—	—	—	—	—
	St. James, Westminster	24,995	—	—	—	—	—	—	1	—	—	—	—	—
N. District.	St. Marylebone	142,404	2	—	—	—	2	1	1	—	[c]1	—	1	—
	Hampstead	68,416	—	—	1	—	—	—	—	—	—	—	—	—
	St. Pancras	234,372	1	1	3	—	1	—	4	—	2	1	5	—
	Islington	319,145	5	—	4	2	5	—	2	—	4	—	1	1
	Hackney	229,542	6	1	11	—	2	—	5	—	3	1	2	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	1	—	—	—	—	—	2	—	—	—	1	—
	St. Martin-in-the-Fields	14,616	—	—	—	—	—	—	—	—	—	—	—	—
	Strand†	25,217	—	—	—	—	—	—	4	—	—	—	—	—
	Holborn‡	34,043	—	—	—	—	—	—	—	—	2	—	—	—
	Clerkenwell	66,216	—	—	2	—	2	—	—	—	—	—	1	—
	St. Luke, Middlesex	42,440	—	—	—	—	—	—	—	—	—	—	—	—
	London, City of§	37,583	—	—	—	—	1	—	—	—	—	—	—	—
E. District.	Shoreditch	124,009	—	—	2	—	1	—	3	—	—	—	2	—
	Bethnal Green	129,132	1	1	1	—	1	1	3	—	2	—	—	—
	Whitechapel‖	74,420	2	—	—	—	—	—	—	—	1	—	1	—
	St. George-in-the-East	45,795	—	—	—	—	2	1	—	—	—	1	—	—
	Limehouse	57,376	—	—	—	1	1	—	2	—	—	1	1	—
	Mile End Old Town	107,592	—	—	1	1	—	—	1	—	1	—	2	—
	Poplar	166,748	2	—	5	1	7	—	—	—	2	—	3	—
S. District.	St. Saviour, Southwark	27,177	—	—	1	—	—	—	—	—	—	—	—	—
	St. George, Southwark	59,712	—	—	—	—	2	—	2	—	1	—	—	—
	Newington	115,804	—	—	4	—	—	—	1	—	4	—	—	1
	St. Olave, Southwark	12,723	—	—	—	—	—	—	—	—	—	—	—	—
	Bermondsey	84,682	1	—	1	—	2	—	1	—	—	—	—	—
	Rotherhithe	39,255	—	—	—	—	—	—	—	1	1	—	2	—
	Lambeth	275,203	6	1	—	2	5	—	2	—	6	1	1	1
	Battersea	150,558	4	—	1	—	2	1	3	—	2	1	1	—
	Wandsworth	156,943	4	1	2	—	1	2	1	—	4	1	5	—
	Camberwell	235,344	1	—	1	1	2	—	1	—	—	—	6	—
	Greenwich	165,413	2	—	2	1	—	—	2	1	1	1	1	—
	Lewisham	92,647	—	—	1	—	—	—	2	—	2	1	—	—
	Woolwich	40,848	1	1	—	—	1	—	—	—	—	—	—	—
	Plumstead	88,539	—	1	1	—	1	—	1	1	—	—	—	—
	Port of London	—	—	—	—	—	—	—	—	—	—	—	—	—

[a] Estimated actual [illegible]

[b] Cases notified to the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of [illegible]

* Including St. Peters, Westminster (population, 235). † Including Middle Temple (population 55).

ENTERIC FEVER—*continued.*

Weekly Statement, 1st Quarter, 1893—*continued.*													Totals for 1st Quarter, 1893.		Sanitary Areas.
Feb. 18.		Feb. 25.		March 4.		March 11.		March 18.		March 25.		April 1.			
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
58	7	34	9	41	12	40	11	30	5	38	7	24	6	554	102	London.
57	—	*35*	—	*35*	—	*40*	—	*30*	—	*33*	—	*33*	—	*533*	—	(*Administrative County.*)
1	—	—	—	1	—	—	—	—	—	1	—	2	—	15	1	Kensington.
5	1	1	—	3	—	1	2	—	—	—	—	—	—	11	4	Fulham.
—	—	2	—	1	2	2	—	2	—	—	—	—	—	19	2	Hammersmith.
—	1	—	—	2	—	1	—	—	—	—	—	2	—	8	2	Paddington.
3	1	2	—	1	—	2	—	1	—	1	—	—	—	23	4	Chelsea.
1	—	—	—	—	—	—	—	1	—	—	1	1	—	11	2	St. George, Hanover Sq.*
—	—	1	—	—	—	—	—	1	—	—	—	—	—	3	1	Westminster.
—	—	—	—	—	—	1	—	1	1	—	—	—	—	3	1	St. James, Westminster.
1	—	—	—	—	—	—	—	—	—	2	—	1	1	11	2	St. Marylebone.
—	—	—	—	1	—	—	—	—	—	1	—	—	—	3	—	Hampstead.
—	—	1	1	2	—	3	1	—	—	—	—	—	—	22	4	St. Pancras.
3	1	6	2	2	—	3	1	5	1	5	—	2	1	47	9	Islington.
—	—	2	—	1	—	4	—	3	2	3	—	—	—	42	4	Hackney.
1	—	—	—	—	—	—	—	—	—	—	—	—	—	5	—	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Martin-in-the-Fields.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	Strand.†
—	—	1	—	1	2	—	—	—	—	—	—	1	—	5	2	Holborn.‡
1	—	—	1	—	—	—	—	1	—	2	—	1	—	10	1	Clerkenwell.
3	—	1	—	—	2	—	—	1	—	—	—	—	—	5	2	St. Luke, Middlesex.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	London, City of.§
1	1	2	—	2	—	—	—	1	—	—	—	—	—	13	1	Shoreditch.
—	—	2	—	1	—	—	—	—	—	—	—	—	—	11	2	Bethnal Green.
1	—	1	—	2	—	1	—	—	—	3	1	1	—	13	1	Whitechapel.‖
—	—	—	—	—	—	1	—	—	—	—	—	—	—	3	2	St. George-in-the-East.
6	—	—	—	—	1	—	—	—	—	1	—	1	—	12	3	Limehouse.
—	—	1	—	—	—	2	1	1	—	2	—	—	1	11	3	Mile End Old Town.
6	—	1	—	3	—	1	—	—	—	2	2	1	—	33	3	Poplar.
2	—	—	—	1	—	—	—	—	—	—	—	—	—	3	1	St. Saviour, Southwark.
2	—	1	—	1	1	1	—	—	—	1	—	1	—	12	1	St. George, Southwark.
—	—	—	—	3	—	—	1	1	—	2	1	2	1	17	4	Newington.
—	—	—	—	1	—	—	—	—	—	1	—	—	—	2	—	St. Olave, Southwark.
—	—	—	—	1	1	—	—	—	—	—	—	—	—	6	1	Bermondsey.
1	—	1	—	—	1	2	—	—	—	—	—	1	—	8	2	Rotherhithe.
4	1	1	1	2	—	5	2	5	—	1	—	1	—	37	9	Lambeth.
4	1	1	—	3	1	5	2	—	—	2	—	2	—	30	6	Battersea.
5	—	—	—	5	1	—	—	3	—	1	1	—	—	31	6	Wandsworth.
7	—	2	2	1	—	4	—	2	—	5	1	2	2	34	6	Camberwell.
—	—	1	—	—	—	1	1	—	—	—	—	—	—	10	4	Greenwich.
—	—	2	—	1	—	—	—	—	—	1	—	1	—	10	1	Lewisham.
—	—	1	1	—	—	—	—	1	—	—	—	—	—	4	2	Woolwich.
—	—	—	—	1	—	—	—	—	1	1	—	—	—	5	3	Plumstead.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

§ Including Inner Temple (population, 96).

‖ Including Tower of London (population, 868).

	Sanitary Areas.	Population (1891).	Enteric Fever—*continued.* Weekly Statement, 2nd Quarter, 1893. April 8. Cases.	April 8. Deaths.	April 15. Cases.	April 15. Deaths.	April 22. Cases.	April 22. Deaths.	April 29. Cases.	April 29. Deaths.	May 6. Cases.	May 6. Deaths.	May 13. Cases.	May 13. Deaths.
	London	4,232,118	52	5	33	8	39	7	45	8	37	13	48	6
	(*Administrative County*)	—	50	—	32	—	39	—	43	—	37	—	46	—
W. District.	Kensington	166,368	1	—	1	—	—	—	1	1	2	—	—	—
W. District.	Fulham	91,639	—	—	1	—	—	—	—	—	1	—	—	—
W. District.	Hammersmith	97,239	—	—	—	—	1	—	1	—	—	—	—	—
W. District.	Paddington	117,846	—	—	3	—	2	1	1	1	3	—	1	—
W. District.	Chelsea	96,253	—	—	2	—	—	—	—	—	1	—	3	1
W. District.	St. George, Hanover Sq.*	78,599	1	—	—	—	—	—	1	—	2	1	2	—
W. District.	Westminster	55,539	—	—	—	—	—	—	1	—	2	1	—	—
W. District.	St. James, Westminster	24,995	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	St. Marylebone	142,404	4	—	1	—	—	—	2	—	—	1	1	—
N. District.	Hampstead	68,416	—	—	—	—	2	1	—	—	—	—	—	—
N. District.	St. Pancras	234,870	6	—	—	—	—	—	3	—	1	—	—	—
N. District.	Islington	313,143	6	2	1	—	3	—	3	1	1	2	5	—
N. District.	Hackney	229,542	6	—	4	2	2	1	3	1	2	—	6	—
Central District.	St. Giles and St. George, Bloomsbury.	32,782	—	—	—	—	—	—	1	—	—	—	—	—
Central District.	St. Martin-in-the-Fields	14,616	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	Strand†	25,217	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	Holborn‡	34,043	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	Clerkenwell	66,216	1	—	2	—	1	—	4	—	—	—	—	—
Central District.	St. Luke, Middlesex	42,449	—	—	1	1	1	—	1	—	5	1	—	—
Central District.	London, City of §	37,583	—	—	—	—	1	—	—	—	—	—	—	—
E. District.	Shoreditch	124,009	1	—	—	—	—	—	4	—	—	1	1	—
E. District.	Bethnal Green	129,132	1	—	2	—	1	—	2	—	3	—	1	—
E. District.	Whitechapel	74,420	1	—	—	—	2	—	1	1	—	—	—	—
E. District.	St. George-in-the-East	45,736	—	—	—	—	—	—	2	—	—	—	1	—
E. District.	Limehouse	57,376	4	—	2	—	1	—	—	—	1	—	4	—
E. District.	Mile End Old Town	107,592	—	—	—	—	3	—	—	—	1	—	2	—
E. District.	Poplar	166,748	3	1	4	1	8	1	8	2	5	3	6	1
S. District.	St. Saviour, Southwark	27,177	1	—	—	1	—	—	—	—	1	—	—	—
S. District.	St. George, Southwark	50,712	1	1	—	—	—	—	1	1	—	—	—	1
S. District.	Newington	115,804	—	—	1	—	—	—	—	—	—	—	1	—
S. District.	St. Olave, Southwark	12,753	—	—	—	1	1	—	1	—	—	1	—	—
S. District.	Bermondsey	84,082	1	—	1	—	—	—	1	—	—	—	—	—
S. District.	Rotherhithe	39,055	1	—	—	—	—	—	—	—	—	—	—	—
S. District.	Lambeth	275,293	3	—	2	1	1	1	1	—	1	—	3	2
S. District.	Battersea	156,558	1	1	1	—	2	—	—	—	1	1	5	—
S. District.	Wandsworth	156,042	3	—	1	1	1	1	2	—	—	—	1	—
S. District.	Camberwell	233,344	2	—	2	—	2	—	—	—	3	1	2	1
S. District.	Greenwich	165,413	3	—	—	—	3	1	1	—	1	—	—	—
S. District.	Lewisham	92,647	—	—	—	—	1	—	1	—	—	—	—	—
S. District.	Woolwich	40,848	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Plumstead	88,539	—	—	1	—	—	—	—	—	—	—	—	—
S. District.	Port of London	—	1	—	—	—	—	—	—	—	—	—	—	—

† Including Middle Temple (population, 95).

* Including St. Peters Westminster (population, 235).

ENTERIC FEVER—*continued.*

Weekly Statement, 2nd Quarter, 1893—*continued.*														Totals for 2nd Quarter, 1893.		Sanitary Areas.
May 20.		May 27.		June 3.		June 10.		June 17.		June 24.		July 1.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
53	5	42	6	34	7	41	8	74	6	149	15	105	16	752	110	London.
51	—	*41*	—	*34*	—	*42*	—	*73*	—	*143*	—	*98*	—	*735*	—	(*Administrative County.*)
	—	1	—	3	—	—	—	—	—	3	—	1	—	14	1	Kensington.
—	—	1	—	—	—	2	—	2	—	2	1	—	—	9	1	Fulham.
—	—	—	—	—	—	1	—	1	—	3	2	—	—	7	2	Hammersmith.
1	—	1	—	2	—	1	1	—	—	2	—	1	—	18	3	Paddington.
2	—	—	—	1	—	1	—	—	1	1	—	1	—	12	2	Chelsea.
1	—	1	—	—	—	2	—	3	—	1	—	2	—	16	1	St. George, Hanover Sq.*
2	1	—	—	—	—	—	—	6	—	3	—	—	—	14	2	Westminster.
—	—	—	—	—	—	—	—	—	—	1	—	—	—	1	—	St. James, Westminster.
3	—	—	1	—	1	1	—	—	—	1	—	6	1	19	4	St. Marylebone.
—	—	1	—	1	—	—	—	—	—	—	—	1	—	5	1	Hampstead.
4	—	3	2	1	—	—	1	4	—	14	—	10	2	45	5	St. Pancras.
1	—	1	—	—	1	1	—	10	1	5	—	8	1	48	3	Islington.
5	1	6	—	4	—	2	1	3	—	7	—	8	—	57	6	Hackney.
—	—	—	—	—	—	—	—	—	—	1	1	—	—	2	1	St. Giles and St. George, Bloomsbury.
—	—	1	—	—	—	1	—	—	—	—	—	—	—	2	—	St. Martin-in-the-Fields.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Strand.†
—	—	2	—	—	—	—	—	1	—	3	—	2	—	8	—	Holborn.‡
1	—	—	—	—	—	1	—	5	—	2	—	2	—	19	—	Clerkenwell.
1	—	—	—	1	—	1	—	—	—	1	—	1	—	13	2	St. Luke, Middlesex.
1	—	—	—	1	—	—	—	—	—	3	—	—	—	6	—	London, City of.§
2	—	—	—	1	—	2	—	5	—	9	—	5	2	30	3	Shoreditch.
1	—	1	—	1	—	5	1	—	—	4	—	9	1	31	2	Bethnal Green.
—	—	2	—	1	—	—	—	1	—	—	—	1	—	9	1	Whitechapel.‖
3	—	4	—	—	—	—	—	—	—	—	—	2	—	12	—	St. George-in-the-East.
1	—	1	—	1	—	4	—	3	—	8	1	1	2	31	3	Limehouse.
4	1	—	1	3	2	—	—	2	—	12	—	7	2	34	6	Mile End Old Town.
8	2	5	1	—	—	3	2	8	2	30	3	13	2	101	21	Poplar.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	1	St. Saviour, Southwark.
—	—	1	—	—	—	—	—	—	—	4	2	—	—	7	5	St. George, Southwark.
—	—	1	1	2	1	2	—	—	—	4	1	1	—	12	3	Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	2	St. Olave, Southwark.
—	—	—	—	—	—	1	1	3	—	—	—	3	—	10	1	Bermondsey.
—	—	1	—	—	—	1	—	—	—	2	—	—	2	5	2	Rotherhithe.
6	—	2	—	3	1	2	1	5	1	5	1	6	—	40	8	Lambeth.
3	—	4	—	2	—	1	—	1	—	—	1	2	—	23	3	Battersea.
—	—	—	—	2	—	—	—	2	—	3	—	1	—	16	2	Wandsworth.
—	—	2	—	—	1	3	—	4	1	3	—	4	1	27	5	Camberwell.
1	—	—	—	2	—	—	—	1	—	1	—	3	—	16	1	Greenwich.
—	—	—	—	—	—	—	—	2	—	4	1	2	—	10	1	Lewisham.
—	—	—	—	1	—	1	—	2	—	4	—	1	—	9	—	Woolwich.
1	—	—	—	1	—	—	—	—	—	—	1	—	—	3	1	Plumstead.
—	—	—	—	—	—	2	—	—	—	3	—	1	—	7	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).
§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

Sanitary Areas	Population (1881).	Enteric Fever—continued. Weekly Statement, 3rd Quarter 1897. July 8. Cases.	July 8. Deaths.	July 15. Cases.	July 15. Deaths.	July 22. Cases.	July 22. Deaths.	July 29. Cases.	July 29. Deaths.	Aug. 5. Cases.	Aug. 5. Deaths.	Aug. 12. Cases.	Aug. 12. Deaths.
London	4,232,118	102	13	80	15	64	8	80	14	80	21	97	16
(Administrative County)	—	62	—	79	—	63	—	79	—	77	—	89	—
W. District. Kensington	166,368	—	—	1	—	1	—	1	1	1	1	2	—
W. District. Fulham	91,839	1	—	4	—	1	—	1	—	2	—	1	—
W. District. Hammersmith	97,235	—	—	3	—	3	—	1	—	2	1	1	—
W. District. Paddington	117,816	—	—	—	—	1	—	1	1	2	—	1	1
W. District. Chelsea	96,553	—	—	2	—	1	—	—	—	—	—	1	—
W. District. St. George, Hanover Sq.*	78,599	—	—	3	—	—	—	3	—	—	—	4	1
W. District. Westminster	55,520	1	1	1	—	—	—	—	—	2	—	2	—
W. District. St. James, Westminster	24,995	1	—	—	—	—	—	—	—	—	1	1	—
N. District. St. Marylebone	142,161	2	—	—	1	1	1	1	—	1	—	1	—
N. District. Hampstead	68,416	1	—	—	—	4	—	2	—	—	—	1	—
N. District. St. Pancras	234,279	—	1	1	1	3	—	6	—	3	1	3	—
N. District. Islington	313,148	9	1	4	—	2	1	5	—	2	—	6	—
N. District. Hackney	220,542	7	—	7	—	8	2	12	3	10	4	4	—
Central District. St. Giles and St. George Bloomsbury.	39,782	—	—	—	—	—	—	—	—	—	—	2	—
Central District. St. Martin-in-the-Fields	14,618	—	1	—	—	—	—	—	—	—	—	—	—
Central District. Strand†	25,217	—	—	—	—	—	—	—	—	—	—	2	—
Central District. Holborn†	34,043	1	1	—	—	—	—	2	—	2	—	2	1
Central District. Clerkenwell	66,216	2	—	1	1	1	—	2	—	1	1	—	—
Central District. St. Luke, Middlesex	42,440	—	1	1	—	2	—	—	1	2	1	—	2
Central District. London, City of†	37,984	—	—	—	—	—	—	2	—	2	—	—	—
E. District. Shoreditch	124,069	3	—	4	1	2	1	4	—	3	—	3	—
E. District. Bethnal Green	129,193	2	—	6	2	2	1	1	—	3	2	3	—
E. District. Whitechapel	74,420	—	—	1	—	—	—	1	—	1	—	4	—
E. District. St. George-in-the-East	45,795	—	—	—	—	1	—	—	—	1	—	1	—
E. District. Limehouse	37,974	1	—	5	—	3	—	2	1	2	—	3	1
E. District. Mile End Old Town	107,203	4	2	5	1	3	1	3	—	6	1	7	—
E. District. Poplar	166,748	13	1	9	2	8	—	13	4	16	7	5	2
S. District. St. Saviour, Southwark	27,177	1	—	—	—	2	—	—	1	1	—	2	—
S. District. St. George, Southwark	29,712	—	—	—	—	1	—	2	—	1	1	—	—
S. District. Newington	142,804	2	—	—	1	—	—	3	1	—	—	—	—
S. District. St. Olave, Southwark	13,793	—	—	—	—	—	—	—	—	—	—	—	—
S. District. Bermondsey	84,682	1	—	—	—	1	—	—	—	—	—	—	—
S. District. Rotherhithe	36,155	1	—	2	—	1	—	—	—	—	—	—	—
S. District. Lambeth	277,205	3	2	4	2	1	—	5	—	5	—	4	—
S. District. Battersea	165,508	1	—	1	—	4	—	1	1	1	—	1	—
S. District. Wandsworth	174,042	—	—	5	—	2	1	2	—	1	—	5	—
S. District. Clapham	227,241	3	1	6	1	3	—	—	—	3	—	3	—
S. District. Greenwich	146,125	1	1	1	—	1	—	2	2	1	—	3	2
S. District. Lewisham	99,057	—	—	3	—	—	—	—	—	—	—	1	1
S. District. Woolwich	108,108	—	—	—	1	—	—	1	—	—	—	—	—
S. District. Plumstead	88,559	1	—	—	1	1	—	3	—	1	—	3	—
Port of London	—	—	—	—	—	—	—	—	—	—	—	—	—

* The Parish of [illegible] is [illegible].

† [illegible] Metropolitan Asylums Board [illegible] after correction of returns and [illegible].

‡ [illegible] St. Peters, Westminster (population, 236). † Including Middle Temple (population, 46).

ENTERIC FEVER—*continued.*

Weekly Statement, 3rd Quarter, 1893—*continued.*													Totals for 3rd Quarter, 1893.		Sanitary Areas.
Aug. 19.		Aug. 26.		Sept. 2.		Sept. 9.		Sept. 16.		Sept. 23.		Sept. 30.			
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
73	28	74	20	75	13	114	15	107	11	89	21	72	13	1,057	205	London.
73	—	*73*	—	*75*	—	*113*	—	*103*	—	*87*	—	*70*	—	*1,037*	—	(*Administrative County*).
3	—	1	—	—	—	3	—	1	—	—	—	—	—	14	2	Kensington.
—	1	2	—	1	—	2	—	—	1	3	—	2	1	20	3	Fulham.
1	1	2	—	2	—	3	2	—	—	1	—	1	—	20	4	Hammersmith.
1	1	—	—	1	—	2	1	1	—	3	2	2	—	15	6	Paddington.
4	—	1	1	1	1	1	—	4	—	4	1	—	2	19	5	Chelsea.
—	—	2	—	—	—	3	—	3	—	1	—	—	1	19	2	St. George, Hanover Sq.*
1	—	—	—	1	—	—	—	2	—	—	—	—	—	10	1	Westminster.
1	—	—	1	—	—	—	—	2	—	1	—	—	—	6	2	St. James, Westminster.
3	1	3	—	1	—	2	—	1	—	4	—	1	—	21	5	St. Marylebone.
2	—	—	—	—	1	—	—	—	—	—	—	1	—	11	1	Hampstead.
6	1	4	2	3	—	5	1	5	1	3	—	4	—	50	8	St. Pancras.
4	1	5	1	5	2	9	3	10	1	3	—	6	2	70	12	Islington.
4	1	5	2	9	2	19	—	14	1	14	3	11	—	124	16	Hackney.
2	1	—	—	1	1	2	—	—	1	—	—	1	—	8	3	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	St. Martin-in-the-Fields.
—	—	—	—	—	—	—	—	1	—	—	—	—	—	3	—	Strand.†
—	—	—	—	—	—	—	—	—	—	1	2	—	—	8	4	Holborn.‡
2	—	6	—	—	1	1	—	—	1	2	1	—	—	18	5	Clerkenwell.
1	—	—	—	—	1	1	—	1	—	1	1	1	1	10	3	St. Luke, Middlesex.
—	—	1	—	—	—	—	—	—	—	—	—	2	—	7	—	London, City of.§
3	3	5	2	4	—	4	—	9	—	2	2	4	—	52	9	Shoreditch.
2	1	2	1	1	—	3	—	4	—	3	1	2	—	36	8	Bethnal Green.
2	1	1	—	2	—	3	—	3	—	3	—	2	—	23	1	Whitechapel.‖
—	—	—	—	1	—	1	—	—	—	1	—	2	1	8	1	St. George-in-the-East
1	1	2	1	5	—	3	1	4	—	4	1	—	1	35	7	Limehouse.
2	2	8	1	5	—	4	1	2	—	3	2	1	—	53	11	Mile End Old Town.
9	4	3	1	10	—	16	1	19	—	10	2	10	1	141	25	Poplar.
—	—	—	—	1	—	—	—	1	—	—	—	—	—	8	1	St. Saviour, Southwark.
2	—	1	1	1	—	1	2	—	1	2	—	1	—	12	5	St. George, Southwark.
2	—	—	—	2	—	3	—	4	—	2	—	—	—	19	2	Newington.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	St. Olave, Southwark.
1	1	2	—	—	—	4	1	1	—	—	1	1	—	11	3	Bermondsey.
—	1	—	—	1	—	—	—	1	—	1	1	—	—	7	2	Rotherhithe.
1	1	2	—	7	1	5	1	—	1	4	1	5	—	42	9	Lambeth.
1	1	3	1	1	—	1	—	—	—	1	—	4	1	20	4	Battersea.
2	2	1	—	1	—	1	1	1	—	3	—	1	—	25	4	Wandsworth.
3	—	4	4	3	1	4	—	3	1	2	—	1	—	39	8	Camberwell.
4	1	2	—	—	1	5	—	9	2	5	—	2	1	36	10	Greenwich.
2	1	4	1	—	—	—	—	—	—	—	—	1	1	11	4	Lewisham.
—	—	—	—	1	—	—	—	—	—	—	—	1	—	3	1	Woolwich.
1	—	1	—	—	1	1	—	1	—	2	—	1	—	15	2	Plumstead.
—	—	1	—	4	—	2	—	—	—	—	—	—	—	7	—	Port of London.

Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn, (population, 121).

§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

Sanitary Areas.	Population (1891).	Enteric Fever—*continued.* Weekly Statement, 4th Quarter, 1893.													
		Oct. 7.		Oct. 14.		Oct. 21.		Oct. 28.		Nov. 4.		Nov. 11.		Nov. 18.	
		Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
London	4,232,118	93	9	96	21	98	16	74	17	109	17	113	15	140	21
(*Administrative County*)	. .	78	—	94	—	97	—	73	—	101	—	111	—	138	—
W. District. Kensington	166,308	4	1	—	1	4	—	8	—	14	3	3	2	7	2
W. District. Fulham	91,639	4	—	4	1	3	1	1	1	2	—	2	—	3	2
W. District. Hammersmith	97,239	—	—	1	—	—	1	4	—	1	—	3	—	2	1
W. District. Paddington	117,846	1	—	1	1	1	—	—	1	2	—	—	—	3	—
W. District. Chelsea	96,253	2	—	3	—	2	2	2	1	1	—	2	—	2	—
W. District. St. George, Hanover Sq.*	78,589	3	—	1	2	—	—	—	—	1	—	2	—	3	—
W. District. Westminster	55,539	—	—	4	—	—	—	2	—	—	—	2	—	3	—
W. District. St. James, Westminster	24,595	1	1	—	—	1	—	—	—	—	—	2	—	2	1
N. District. St. Marylebone	142,804	2	—	3	1	3	—	1	—	2	1	5	1	3	1
N. District. Hampstead	68,416	1	—	1	—	3	—	1	—	—	—	3	—	1	1
N. District. St. Pancras	234,379	1	—	1	1	3	—	4	1	7	—	7	1	8	2
N. District. Islington	319,148	4	—	8	2	8	—	5	2	10	—	9	1	9	1
N. District. Hackney	229,542	11	2	13	4	9	1	9	3	7	1	14	3	28	2
Central District. St. Giles and St. George, Bloomsbury.	39,782	—	—	3	—	2	—	2	—	—	—	—	—	2	—
Central District. St. Martin-in-the-Fields	14,616	—	—	—	—	—	—	1	—	1	—	—	—	—	—
Central District. Strand†	25,217	—	—	—	—	1	—	—	1	—	—	1	—	—	—
Central District. Holborn‡	34,943	1	—	—	—	3	1	3	—	1	2	—	1	3	—
Central District. Clerkenwell	63,216	—	—	2	—	3	1	—	—	3	1	6	—	4	—
Central District. St. Luke, Middlesex	42,440	—	—	—	—	1	—	2	—	—	—	—	—	—	—
Central District. London, City of§	37,583	1	—	1	—	2	—	—	—	3	—	—	—	1	—
E. District. Shoreditch	124,009	3	—	4	—	2	—	—	—	3	—	3	—	2	—
E. District. Bethnal Green	129,132	3	1	5	—	5	—	2	1	3	1	5	2	6	2
E. District. Whitechapel	74,420	1	1	1	—	4	—	1	—	—	—	—	—	6	—
E. District. St. George-in-the-East	45,795	4	—	—	—	1	—	—	—	—	—	7	—	1	—
E. District. Limehouse	57,876	6	—	4	1	3	2	5	—	—	—	2	1	1	—
E. District. Mile End Old Town	167,592	5	—	6	2	6	—	2	1	5	1	4	2	6	—
E. District. Poplar	166,748	15	1	13	1	5	2	3	2	10	—	6	—	9	—
S. District. St. Saviour, Southwark	27,177	—	—	—	—	—	—	—	—	1	—	1	—	—	—
S. District. St. George, Southwark	59,712	—	—	3	—	1	—	1	1	—	—	1	—	—	—
S. District. Newington	115,804	—	1	3	—	1	—	—	—	6	—	1	—	1	—
S. District. St. Olave, Southwark	12,723	—	—	1	—	—	—	—	—	—	—	—	—	—	—
S. District. Bermondsey	84,682	1	—	1	—	2	—	—	—	2	—	2	—	3	1
S. District. Rotherhithe	39,255	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District. Lambeth	275,265	2	—	4	—	3	2	1	1	7	1	—	—	3	1
S. District. Battersea	159,558	4	—	4	—	2	—	3	—	2	1	6	—	3	1
S. District. Wandsworth	156,042	3	—	—	2	4	1	2	—	6	—	1	—	3	1
S. District. Camberwell	235,344	3	—	—	—	5	1	4	1	3	2	5	1	6	—
S. District. Greenwich	105,413	2	1	—	1	3	1	4	—	3	3	3	—	7	1
S. District. Lewisham	92,647	3	—	1	1	—	—	—	—	—	—	3	—	1	—
S. District. Woolwich	40,848	—	—	—	—	—	—	—	—	1	—	—	—	—	—
S. District. Plumstead	88,539	2	—	1	—	2	—	1	—	2	—	2	—	2	—
S. District. Port of London	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

* Including Hanover Square.

† Including only the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicates and mistakes.

‡ Including St. Peters, Westminster (population 235).

§ Including Middle Temple (population 95).

ENTERIC FEVER—*continued.*

Weekly Statement, 4th Quarter, 1893—*continued.*												Totals for 4th Quarter, 1893.		Grand Totals for Year 1893.		Sanitary Areas.
Nov. 25.		Dec. 2.		Dec. 9.		Dec. 16.		Dec. 23.		Dec. 30.						
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
162	24	138	24	118	33	92	21	69	23	81	17	1,383	258	3,746	675	London.
153	—	*135*	—	*113*	—	*91*	—	*69*	—	*79*	—	*1,350*	—	*3,660*	—	(*Administrative County.*)
5	1	5	—	3	1	2	1	3	—	2	1	60	13	103	17	Kensington.
2	1	—	—	—	3	—	—	—	—	—	—	21	9	61	17	Fulham.
2	—	—	1	—	—	1	—	5	1	3	3	22	7	68	15	Hammersmith.
4	2	10	2	1	2	—	—	1	2	5	—	29	10	70	21	Paddington.
1	—	6	1	2	1	—	—	1	—	1	1	25	6	79	17	Chelsea.
3	1	5	—	2	1	1	2	1	1	3	—	25	7	71	12	St. George, Hanover Sq.*
1	—	4	2	—	—	1	—	—	1	1	—	18	3	45	7	Westminster.
4	—	—	—	1	—	—	1	—	—	1	—	12	3	22	6	St. James, Westminster.
12	1	7	—	3	1	3	—	1	2	3	1	48	9	99	20	St. Marylebone.
1	1	1	1	2	—	1	2	—	1	2	—	17	6	36	8	Hampstead.
9	1	6	2	8	1	8	—	5	—	1	1	67	10	184	27	St. Pancras.
11	2	6	1	12	2	12	1	7	4	4	2	105	18	270	47	Islington.
11	2	8	3	12	2	11	1	10	2	4	1	146	27	369	53	Hackney.
2	—	3	—	1	—	1	1	2	1	—	—	18	2	33	6	St. Giles and St. George, Bloomsbury.
—	—	—	—	1	—	1	—	—	—	—	—	4	—	6	1	St. Martin-in-the-Fields.
2	—	—	—	—	—	1	—	—	—	—	—	5	1	12	1	Strand.†
3	2	2	—	1	1	2	—	—	—	1	—	20	7	41	13	Holborn.‡
—	1	—	—	3	—	1	1	—	—	2	—	24	4	71	10	Clerkenwell.
—	—	—	—	—	—	—	—	1	—	—	—	4	—	32	12	St. Luke, Middlesex.
1	—	—	—	1	—	2	—	—	—	2	—	14	—	28	—	London, City of.§
4	1	2	2	3	—	—	—	—	—	—	—	26	3	121	16	Shoreditch.
3	—	7	1	3	—	6	1	2	3	12	1	62	13	140	25	Bethnal Green.
5	1	1	—	—	1	—	—	—	1	1	1	20	5	65	8	Whitechapel.‖
7	—	1	—	1	—	1	—	—	—	1	1	24	1	47	4	St. George-in-the-East.
5	—	4	—	4	1	1	—	1	—	1	—	37	5	115	18	Limehouse.
7	1	4	—	3	1	1	—	2	—	2	1	53	9	151	29	Mile End Old Town.
11	1	16	1	11	3	10	2	5	—	7	—	121	13	396	62	Poplar.
3	—	—	—	1	—	1	—	—	—	1	—	8	—	21	3	St. Saviour, Southwark.
3	—	1	—	1	—	—	—	—	1	—	—	11	2	42	13	St. George, Southwark.
—	1	3	—	2	1	—	—	—	—	3	1	20	4	68	13	Newington.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	6	2	St. Olave, Southwark.
3	—	2	—	—	1	—	—	2	—	3	—	21	3	48	8	Bermondsey.
1	—	2	—	3	2	—	—	1	—	—	—	7	2	27	8	Rotherhithe.
5	—	8	1	1	2	4	2	2	—	2	—	41	10	160	36	Lambeth.
7	2	5	2	11	—	6	2	1	1	4	—	57	9	130	22	Battersea.
6	—	9	1	4	1	1	—	—	—	3	—	43	6	115	18	Wandsworth.
4	1	1	—	4	—	4	—	4	1	1	1	42	8	142	27	Camberwell.
10	—	3	2	7	3	6	1	6	—	2	—	56	13	118	28	Greenwich.
2	—	1	—	—	—	—	1	1	1	2	—	14	3	45	9	Lewisham.
1	—	1	—	3	1	1	1	5	—	1	—	13	2	29	5	Woolwich.
1	1	3	1	2	1	2	1	—	—	—	1	20	5	43	11	Plumstead.
—	—	1	—	1	—	—	—	—	—	—	—	2	—	17	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

§ Including Inner Temple (population, 96). ‖ Including Tower of London (population. 868).

	Sanitary Areas.	Population (1891).	Simple Continued Fever. Weekly Statement, 1st Quarter, 1893. Jan. 7. Cases.	Jan. 7. Deaths.	Jan. 14. Cases.	Jan. 14. Deaths.	Jan. 21. Cases.	Jan. 21. Deaths.	Jan. 28. Cases.	Jan. 28. Deaths.	Feb. 4. Cases.	Feb. 4. Deaths.	Feb. 11. Cases.	Feb. 11. Deaths.
	London	4,232,118	[a]6	—	3	—	1	1	2	—	6	1	2	—
	(*Administrative County*)	—	[b]6	—	3	—	2	—	2	—	6	—	2	—
W. District.	Kensington	166,308	—	—	—	—	—	—	—	—	1	—	—	—
W. District.	Fulham	91,639	—	—	—	—	—	—	—	—	—	—	—	—
W. District.	Hammersmith	97,239	—	—	—	—	—	—	—	—	—	—	—	—
W. District.	Paddington	117,846	1	—	—	—	—	—	—	—	—	—	—	—
W. District.	Chelsea	96,253	—	—	—	—	—	—	—	—	—	—	—	—
W. District.	St. George, Hanover Sq.*	78,599	—	—	—	—	—	1	—	—	—	—	—	—
W. District.	Westminster	55,539	—	—	—	—	—	—	—	—	—	—	—	—
W. District.	St. James, Westminster	24,995	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	St. Marylebone	142,404	—	—	—	—	—	—	—	—	1	1	—	—
N. District.	Hampstead	68,416	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	St. Pancras	234,379	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	Islington	319,143	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	Hackney	229,542	—	—	—	—	—	—	—	—	1	—	—	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	St. Martin-in-the-Fields	14,616	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	Strand†	25,217	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	Holborn‡	34,043	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	Clerkenwell	66,216	—	—	—	—	—	—	1	—	—	—	1	—
Central District.	St. Luke, Middlesex	42,449	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	London, City of§	37,583	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Shoreditch	124,009	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Bethnal Green	129,132	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Whitechapel‖	74,420	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	St. George-in-the-East	45,795	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Limehouse	57,376	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Mile End Old Town	107,592	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Poplar	166,748	—	—	1	—	—	—	1	—	—	—	—	—
S. District.	St. Saviour, Southwark	27,177	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	St. George, Southwark	59,712	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Newington	115,804	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	St. Olave, Southwark	12,723	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Bermondsey	84,682	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Rotherhithe	39,255	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Lambeth	275,203	—	—	1	—	1	—	—	—	3	—	—	—
S. District.	Battersea	150,558	5	—	1	—	—	—	—	—	—	—	—	—
S. District.	Wandsworth	156,942	—	—	—	—	—	—	—	—	—	—	1	—
S. District.	Camberwell	235,344	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Greenwich	165,413	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Lewisham	92,647	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Woolwich	40,848	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Plumstead	88,539	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Port of London	—	—	—	—	—	—	—	—	—	—	—	—	—

[a] Totals of actual *notifications*.
[b] Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicate notifications.
* Including St. Peters, Westminster (population, 235). † Including Middle Temple (population, 95).

SIMPLE CONTINUED FEVER—*continued.*

Weekly Statement, 1st Quarter, 1893—*continued.*														Totals for 1st Quarter, 1893.		Sanitary Areas.
Feb. 18.		Feb. 25.		Mar. 4.		Mar. 11.		Mar. 18.		Mar. 25.		April 1.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
2	—	6	—	4	—	—	—	3	—	2	—	1	1	38	3	London.
2	—	*5*	—	4	—	—	—	*3*	—	*2*	—	*1*	—	*33*	—	(*Administrative County.*)
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Kensington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Fulham.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Hammersmith.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Paddington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Chelsea.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	St. George, Hanover Sq.*
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Westminster.
—	—	1	—	—	—	—	—	—	—	—	—	—	1	1	1	St. James, Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	St. Marylebone.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Hampstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Pancras.
—	—	2	—	1	—	—	—	—	—	—	—	—	—	3	—	Islington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Hackney.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Martin-in-the-Fields.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Strand.†
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Holborn.‡
1	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	Clerkenwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Luke, Middlesex.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	London, City of.§
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Shoreditch.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Bethnal Green.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Whitechapel.‖
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George-in-the-East.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Limehouse.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Mile End Old Town.
1	—	2	—	—	—	—	—	2	—	—	—	—	—	7	—	Poplar.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Saviour, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Olave, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Bermondsey.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Rotherhithe.
—	—	1	—	2	—	—	—	1	—	1	—	1	—	11	—	Lambeth.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	6	—	Battersea.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Wandsworth.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Camberwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Greenwich.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Lewisham.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Woolwich.
—	—	—	—	1	—	—	—	—	—	1	—	—	—	2	—	Plumstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

Sanitary Areas.	Population (1891).	Simple Continued Fever—*continued.* Weekly Statement, 2nd Quarter, 1893.											
		April 8.		April 15.		April 22.		April 29.		May 6.		May 13.	
		Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
London	4,232,118	[a]1	1	—	—	1	—	—	1	4	—	2	—
(*Administrative County*)	—	[b]1	—	—	—	[b]1	—	—	—	4	—	2	—
W. District. Kensington	166,308	—	—	—	—	—	—	—	—	—	—	—	—
W. District. Fulham	91,639	—	—	—	—	—	—	—	—	—	—	—	—
W. District. Hammersmith	97,239	—	—	—	—	—	—	—	—	—	—	—	—
W. District. Paddington	117,846	—	—	—	—	—	—	—	—	—	—	—	—
W. District. Chelsea	96,253	—	—	—	—	—	—	—	1	—	—	—	—
W. District. St. George, Hanover Sq.*	78,599	—	—	—	—	—	—	—	—	—	—	—	—
W. District. Westminster	55,539	—	—	—	—	—	—	—	—	—	—	—	—
W. District. St. James, Westminster	24,995	1	—	—	—	—	—	—	—	—	—	—	—
N. District. St. Marylebone	142,404	—	—	—	—	1	—	—	—	—	—	—	—
N. District. Hampstead	68,416	—	—	—	—	—	—	—	—	1	—	—	—
N. District. St. Pancras	234,379	—	—	—	—	—	—	—	—	—	—	—	—
N. District. Islington	319,143	—	1	—	—	—	—	—	—	—	—	—	—
N. District. Hackney	229,542	—	—	—	—	—	—	—	—	1	—	—	—
E. District. St. Giles and St. George, Bloomsbury.	39,782	—	—	—	—	—	—	—	—	—	—	—	—
E. District. St. Martin-in-the-Fields	14,616	—	—	—	—	—	—	—	—	—	—	—	—
E. District. Strand†	25,217	—	—	—	—	—	—	—	—	—	—	—	—
E. District. Holborn‡	34,043	—	—	—	—	—	—	—	—	—	—	—	—
E. District. Clerkenwell	66,216	—	—	—	—	—	—	—	—	—	—	—	—
E. District. St. Luke, Middlesex	42,440	—	—	—	—	—	—	—	—	—	—	—	—
E. District. London, City of§	37,583	—	—	—	—	—	—	—	—	—	—	—	—
E. District. Shoreditch	124,009	—	—	—	—	—	—	—	—	—	—	—	—
E. District. Bethnal Green	129,132	—	—	—	—	—	—	—	—	—	—	—	—
E. District. Whitechapel‖	74,420	—	—	—	—	—	—	—	—	—	—	—	—
E. District. St. George-in-the-East	45,795	—	—	—	—	—	—	—	—	—	—	—	—
E. District. Limehouse	57,376	—	—	—	—	—	—	—	—	—	—	—	—
E. District. Mile End Old Town	107,592	—	—	—	—	—	—	—	—	—	—	—	—
E. District. Poplar	166,748	—	—	—	—	—	—	—	—	—	—	—	—
S. District. St. Saviour, Southwark	27,177	—	—	—	—	—	—	—	—	—	—	—	—
S. District. St. George, Southwark	59,712	—	—	—	—	—	—	—	—	1	—	—	—
S. District. Newington	115,804	—	—	—	—	—	—	—	—	—	—	—	—
S. District. St. Olave, Southwark	12,723	—	—	—	—	—	—	—	—	—	—	—	—
S. District. Bermondsey	84,682	—	—	—	—	—	—	—	—	—	—	—	—
S. District. Rotherhithe	39,255	—	—	—	—	—	—	—	—	—	—	—	—
S. District. Lambeth	275,203	—	—	—	—	—	—	—	—	—	—	1	—
S. District. Battersea	150,553	—	—	—	—	—	—	—	—	—	—	1	—
S. District. Wandsworth	156,942	—	—	—	—	—	—	—	—	—	—	—	—
S. District. Camberwell	237,344	—	—	—	—	—	—	—	—	1	—	—	—
S. District. Greenwich	165,413	—	—	—	—	—	—	—	—	—	—	—	—
S. District. Lewisham	92,647	—	—	—	—	—	—	—	—	—	—	—	—
S. District. Woolwich	40,848	—	—	—	—	—	—	—	—	—	—	—	—
S. District. Plumstead	88,539	—	—	—	—	—	—	—	—	—	—	—	—
S. District. Port of London	—	—	—	—	—	—	—	—	—	—	—	—	—

[a] Totals of actual *notifications.*

[b] Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deductions of duplicate notifications.

* Including St. Peters, Westminster (population, 235). † Including Middle Temple (population, 95).

SIMPLE CONTINUED FEVER—*continued.*

Weekly Statement, 2nd Quarter, 1893—*continued.*														Totals for 2nd Quarter, 1893.		Sanitary Areas.
May 20.		May 27.		June 3.		June 10.		June 17.		June 24.		July 1.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
5		5	—	3	—	4	—	2	1	8	—	10	1	45	4	London.
4	–	*5*	—	*2*	—	*4*	—	*2*	—	*3*	—	*10*	—	*43*	—	(*Administrative County.*)
—	–	2	—	1	—	—	—	—	—	—	—	—	—	3	—	Kensington.
3	–	—	—	—	—	—	—	—	—	—	—	—	—	3	—	Fulham.
—	—	—	—	—	—	—	—	1	—	—	—	—	—	1	—	Hammersmith.
—	–	—	—	—	—	—	—	1	—	1	—	—	—	2	—	Paddington.
—	–	—	—	—	—	—	—	—	—	—	—	—	—	—	1	Chelsea.
—	—	1	—	—	—	—	—	—	—	—	—	—	—	1	—	St. George, Hanover Sq.*
—	–	—	—	—	—	—	—	—	1	—	—	—	—	—	1	Westminster.
—	–	—	—	—	—	—	—	—	—	—	—	—	—	1	—	St. James, Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	St. Marylebone.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Hampstead.
—	—	—	—	1	—	—	—	—	—	1	—	—	—	2	—	St. Pancras.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	1	Islington
—	—		—	–	—	1	—	–	–	—	—	1	1	3	1	Hackney.
—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Giles and St. George, Bloomsbury.
—	–	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Martin-in-the-Fields.
–	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Strand.†
	–	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Holborn.‡
.	—	—	—	—	—	—	—	—	—	—	—	2	—	2	—	Clerkenwell.
	–	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Luke, Middlesex.
.	–	—	—	—	—	—	—	—	—	—	—	—	—	—	—	London, City of.§
—	—	—	—	—	—	1	—	—	—	—	—	1	—	2	—	Shoreditch
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Bethnal Green.
–	–	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Whitechapel.‖
–		—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George-in-the-East.
—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	Limehouse.
—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	Mile End Old Town.
—	—	—	—	1	—	—	—	—	—	—	—	1	—	2	—	Poplar.
	–	—	—	—	—	—		—	—	—	—	—	—	—	—	St. Saviour, Southwark.
.	—	—	—	—	—	—		—	—	—	—	—	—	1	—	St. George, Southwark.
—	—	—	—	—	—	1	—	–	—	—	—	—	—	1	—	Newington.
—	—	—		–		–		—	–	–		–		—	—	St. Olave, Southwark.
	–	–		—	—		—		—	—	—	—	—	—	—	Bermondsey.
—	–	–	–	–	—	–	—		—	—	—	—	—	—	—	Rotherhithe.
–	—	2		—	—	1	—		—	4	—	4	—	12	—	Lambeth.
.	—	—	—	–	—	–	–		—	—	—	—	—	1	—	Battersea.
	—	—	—	—	—		—		—	–		—		—	—	Wandsworth.
1	—	—		–	—	–	—		—	2	—	—	—	4	—	Camberwell.
1	—	—		—	—	—			—	–		—	–	1	—	Greenwich.
	–	—		—	—	—	–	–	—	—	—	—	—	—	—	Lewisham.
–		—		—	—	–	–	–	—	—	–	–		—	—	Woolwich.
–	—	—	—	—	—	–	–	–	—	—	—	—	—	—	—	Plumstead.
—	–	–		—	—	–	–	—	–	–	–	—		—	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).
§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

Sanitary Areas.	Population (1891.)	Simple Continued Fever—*continued.* Weekly Statement, 3rd Quarter, 1893. July 8. Cases.	July 8. Deaths.	July 15. Cases.	July 15. Deaths.	July 22. Cases.	July 22. Deaths.	July 29. Cases.	July 29. Deaths.	Aug. 5. Cases.	Aug. 5. Deaths.	Aug. 12. Cases.	Aug. 12. Deaths.
London	4,232,118	3	—	6	1	4	—	3	1	5	2	4	1
(*Administrative County*)	—	*3*	—	*6*	—	*4*	—	*3*	—	*5*	—	*2*	—
W. District, Kensington	166,308	—	—	—	—	—	—	—	—	—	—	—	—
W. District, Fulham	91,639	—	—	—	—	—	—	—	—	—	—	—	—
W. District, Hammersmith	97,239	—	—	—	—	—	—	—	—	—	—	—	—
W. District, Paddington	117,846	—	—	—	—	1	—	—	—	—	—	—	—
W. District, Chelsea	96,253	—	—	—	—	—	—	—	—	—	—	—	—
W. District, St. George, Hanover Sq.*	78,599	1	—	—	1	—	—	—	—	—	—	—	—
W. District, Westminster	55,539	—	—	—		—	—	-	—	—	—	—	-
W. District, St. James, Westminster	24,995	—	—	—	—	—	—	—	—	—	—	—	—
N. District, St. Marylebone	142,404	-		—	—	—	—	-	-	-	—	—	-
N. District, Hampstead	68,416	—	—	—	—	—	—	—	—	—	—	—	—
N. District, St. Pancras	234,379	—	—	—	—	—	—	—	—	—	—	—	—
N. District, Islington	319,143	—	—	—	—	—	—	—	—	—	—	—	—
N. District, Hackney	229,542	—	—	—	—	—	—	—	—	—	—	—	—
Central District, St. Giles and St. George, Bloomsbury.	30,782	—	—	—	—	—	—	—	—	—	—	—	—
Central District, St. Martin-in-the-Fields	14,616	—	—	—	—	—	—	—	—	—	—	—	—
Central District, Strand†	25,217	—	—	—	—	—	—	—	—	—	—	—	—
Central District, Holborn‡	34,043	—	—	—	—	—	—	—	—	—	—	—	—
Central District, Clerkenwell	66,216	—	—	—	—	—	—	1	—	—	—	—	—
Central District, St. Luke, Middlesex	42,440	—	—	—	—	—	—	—	—	1	—	—	—
Central District, London, City of§	37,583	—	—	—	—	—	—	—	—	—	1	1	—
E. District, Shoreditch	124,009	—	—	—	—	—	—	—	1	—	—	—	—
E. District, Bethnal Green	129,132	—	—	—	—	—	—	—	—	1	—	—	—
E. District, Whitechapel‖	74,420	—	—	—	—	—	—	—	—	—	—	—	—
E. District, St. George-in-the-East	45,795	—	—	—	—	—	—	—	—	—	—	—	—
E. District, Limehouse	57,376	—	—	—	—	—	—	—	—	—	—	—	—
E. District, Mile End Old Town	107,592	—	—	—	—	—	—	—	—	—	—	—	—
E. District, Poplar	166,748	—	—	3	—	—	—	1	—	1	—	1	—
S. District, St. Saviour, Southwark	27,177	—	—	—	—	—	—	—	—	—	—	—	—
S. District, St. George, Southwark	59,712	—	—	—	—	—	—	—	—	—	—	—	—
S. District, Newington	115,804	—	—	—	—	—	—	—	—	—	—	—	—
S. District, St. Olave, Southwark	12,723	—	—	—	—	—	—	—	—	—	—	—	—
S. District, Bermondsey	84,682	—	—	—	—	—	—	—	—	—	—	—	—
S. District, Rotherhithe	39,255	—	—	—	—	—	—	—	—	—	—	—	—
S. District, Lambeth	275,203	1	—	2	—	3	—	1	—	2	—	2	1
S. District, Battersea	150,558	—	—	—	—	—	—	—	—	—	—	—	—
S. District, Wandsworth	156,942	1	—	1	—	—	—	—	—	—	1	—	—
S. District, Camberwell	235,344	—	—	—	—	—	—	—	—	—	—	—	—
S. District, Greenwich	165,413	—	—	—	—	—	—	—	—	—	—	—	—
S. District, Lewisham	92,647	—	—	—	—	—	—	—	—	—	—	—	—
S. District, Woolwich	40,848	—	—	—	—	—	—	—	—	—	—	—	—
S. District, Plumstead	88,539	—	—	—	—	—	—	—	—	—	—	—	—
S. District, Port of London	—	—	—	—	—	—	—	—	—	—	—	—	—

[a] Totals of actual *notifications*.
[b] Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicate notifications.
* Including St. Peters, Westminster (population, 235). † Including Middle Temple (population, 95).

SIMPLE CONTINUED FEVER—*continued.*

Weekly Statement, 3rd Quarter, 1893—*continued.*														Totals for 3rd Quarter, 1893.		Sanitary Areas.
Aug. 19.		Aug. 26.		Sept. 2.		Sept. 9.		Sept. 16.		Sept. 23.		Sept. 30.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
8	1	3	—	5	—	1	—	5	—	4	1	6	—	57	7	London.
8	—	*3*	—	4	—	*1*	—	*5*	—	4	—	4	—	*52*	—	(*Administrative County.*)
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Kensington.
—	—	—	—	1	—	—	—	1	—	—	—	—	—	2	—	Fulham.
1	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Hammersmith.
1	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	Paddington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Chelsea.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	St. George, Hanover Sq.*
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Westminster.
—	—	—	—	—	—	—	—	1	—	—	—	—	—	1	—	St. James, Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Marylebone.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Hampstead.
—	—	—	—	—	—	—	—	—	—	1	—	—	—	1	—	St. Pancras.
—	—	—	—	—	—	1	—	—	—	—	—	—	—	1	—	Islington.
—	—	—	—	—	—	—	—	1	—	—	—	—	—	1	—	Hackney.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Martin-in-the-Fields.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Strand.†
—	—	—	—	—	—	—	—	—	—	—	—	2	—	2	—	Holborn.‡
—	—	—	—	1	—	—	—	—	—	—	—	—	—	2	—	Clerkenwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	St. Luke, Middlesex.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	London, City of.§
—	—	1	—	—	—	—	—	—	—	—	—	—	—	1	1	Shoreditch.
1	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	Bethnal Green.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Whitechapel.‖
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George-in-the-East.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Limehouse.
—	—	—	—	1	—	—	—	—	—	—	—	—	—	1	—	Mile End Old Town.
3	—	—	—	1	—	—	—	—	—	—	—	2	—	12	—	Poplar.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Saviour, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Olave, Southwark.
1	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Bermondsey.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Rotherhithe.
1	1	2	—	1	—	—	—	2	—	3	1	2	—	22	3	Lambeth.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Battersea.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	1	Wandsworth.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Camberwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Greenwich.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Lewisham.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Woolwich.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Plumstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

Sanitary Areas.	Population (1891).	Simple Continued Fever—*continued.* Weekly Statement, 4th Quarter, 1893.													
		Oct. 7.		Oct. 14.		Oct. 21.		Oct. 28.		Nov. 4.		Nov. 11.		Nov. 18.	
		Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
London	4,232,118	[a]7	—	8	—	6	1	6	1	4	1	7	1	4	—
(*Administrative County*)	- -	[b]7	—	7	—	4	—	6	—	4	—	7	—	3	—
W. District. Kensington	166,308	—	—	—	—	—	—	—	—	1	—	1	—	2	—
W. District. Fulham	91,639	—	—	—	—	—	—	—	—	—	—	—	—	—	—
W. District. Hammersmith	97,239	—	—	—	—	—	—	—	—	—	—	—	—	—	—
W. District. Paddington	117,846	—	—	—	—	—	—	—	—	—	—	—	—	1	—
W. District. Chelsea	96,253	—	—	1	—	—	1	—	—	—	—	—	—	—	—
W. District. St. George, Hanover Sq.*	78,599	—	—	—	—	—	—	—	—	—	—	—	—	—	—
W. District. Westminster	55,539	—	—	—	—	—	—	—	—	—	—	—	—	—	—
W. District. St. James, Westminster	24,995	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N. District. St. Marylebone	142,404	—	—	—	—	—	—	—	—	1	—	—	—	—	—
N. District. Hampstead	68,416	—	—	1	—	—	—	—	—	—	—	—	—	—	—
N. District. St. Pancras	234,379	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N. District. Islington	319,143	—	—	—	—	1	—	—	—	—	—	—	—	—	—
N. District. Hackney	229,542	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Central District. St. Giles and St. George, Bloomsbury.	39,782	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Central District. St. Martin-in-the-Fields	14,616	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Central District. Strand†	25,217	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Central District. Holborn‡	34,043	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Central District. Clerkenwell	66,216	—	—	—	—	—	—	—	—	—	—	1	—	—	—
Central District. St. Luke, Middlesex	42,440	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Central District. London, City of§	37,583	—	—	—	—	—	—	—	—	—	—	—	—	—	—
E. District. Shoreditch	124,009	—	—	—	—	—	—	—	—	—	—	—	—	—	—
E. District. Bethnal Green	129,132	—	—	—	—	1	—	—	—	—	—	—	—	—	—
E. District. Whitechapel‖	74,420	—	—	—	—	—	—	—	—	—	—	—	—	—	—
E. District. St. George-in-the-East	45,795	—	—	—	—	—	—	—	—	—	—	1	—	—	—
E. District. Limehouse	57,376	—	—	—	—	—	—	—	—	—	—	—	—	—	—
E. District. Mile End Old Town	107,592	—	—	—	—	—	—	—	—	—	—	—	—	—	—
E. District. Poplar	166,748	4	—	3	—	2	—	1	—	1	—	1	—	—	—
S. District. St. Saviour, Southwark	27,177	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District. St. George, Southwark	59,712	—	—	—	—	—	—	1	—	—	—	—	—	—	—
S. District. Newington	115,804	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District. St. Olave, Southwark	12,723	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District. Bermondsey	84,682	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District. Rotherhithe	39,255	—	—	—	—	—	—	1	—	—	—	—	—	—	—
S. District. Lambeth	275,203	2	—	—	—	2	—	3	1	—	—	2	—	—	—
S. District. Battersea	150,558	—	—	—	—	—	—	—	—	—	—	1	—	—	—
S. District. Wandsworth	156,942	—	—	1	—	—	—	—	—	—	—	—	—	1	—
S. District. Camberwell	235,344	1	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District. Greenwich	165,413	—	—	1	—	—	—	—	—	—	—	—	—	—	—
S. District. Lewisham	92,647	—	—	—	—	—	—	—	—	—	1	—	—	—	—
S. District. Woolwich	40,848	—	—	—	—	—	—	—	—	1	—	—	1	—	—
S. District. Plumstead	88,539	—	—	1	—	—	—	—	—	—	—	—	—	—	—
S. District. Port of London	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

[a] Totals of actual *notifications.*
[b] Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicate notifications.
* Including St. Peters, Westminster (population, 235). † Including Middle Temple (population, 95).

SIMPLE CONTINUED FEVER—*continued.*

Weekly Statement, 4th Quarter, 1893—*continued.*											Totals for 4th Quarter, 1893.		Grand Totals for Year 1893.		Sanitary Areas.
Nov. 25.		Dec. 2.		Dec. 9.		Dec. 16.		Dec. 23.		Dec. 30.					
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
5	1	8	—	4	1	12	—	3	—	3	1	77	7	217	21	London.
5	—	*8*	—	4	—	*12*	—	*3*	—	*3*	—	*73*	—	*206*	—	(*Administrative County.*)
—	—	1	—	—	—	1	—	1	—	—	—	7	—	11	—	Kensington.
1	—	—	—	—	—	—	—	—	—	—	—	1	—	6	—	Fulham.
—	—	—	—	—	1	2	—	—	—	—	1	2	2	4	2	Hammersmith.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	6	—	Paddington.
—	—	—	—	—	—	—	—	—	—	—	—	1	1	1	2	Chelsea.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	2	St. George, Hanover Sq.*
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	1	St. James, Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	3	1	St. Marylebone.
—	—	—	—	—	—	—	—	1	—	—	—	2	—	3	—	Hampstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	St. Pancras.
1	—	—	—	1	—	—	—	—	—	—	—	3	—	8	1	Islington.
—	—	1	—	—	—	1	—	—	—	—	—	2	—	7	1	Hackney.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Martin-in-the-Fields.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Strand.†
—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	Holborn.‡
—	—	—	—	—	—	—	—	—	—	—	—	1	—	8	—	Clerkenwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	St. Luke, Middlesex.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	London, City of.§
—	—	—	—	—	—	1	—	—	—	—	—	1	—	4	1	Shoreditch.
—	—	—	—	—	—	—	—	—	—	—	—	2	—	4	—	Bethnal Green.
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Whitechapel.‖
—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	St. George-in-the-East.
—	—	—	—	—	—	1	—	—	—	—	—	1	—	1	—	Limehouse.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Mile End Old Town.
—	—	2	—	—	—	1	—	—	—	1	—	16	—	37	—	Poplar.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Saviour, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	2	—	St. George, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Olave, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Bermondsey.
—	—	1	—	—	—	—	—	—	—	1	—	3	—	3	—	Rotherhithe.
2	—	3	—	3	—	—	—	—	—	1	—	18	1	63	4	Lambeth.
—	—	—	—	—	—	1	—	—	—	—	—	2	—	9	—	Battersea.
—	—	—	—	—	—	1	—	—	—	—	—	3	—	6	1	Wandsworth.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	5	—	Camberwell.
—	—	—	—	—	—	—	—	—	—	—	—	4	1	5	1	Greenwich.
—	1	—	—	—	—	2	—	1	—	—	—	—	1	—	1	Lewisham.
—	—	—	—	—	—	—	—	—	—	—	—	2	1	2	1	Woolwich.
—	—	—	—	—	—	1	—	—	—	—	—	1	—	3	—	Plumstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136). Staple Inn (population, 21), and Furnival's Inn (population, 121).

§ Including Inner Temple (population, 96).

‖ Including Tower of London (population, 868).

Sanitary Areas.	Population (1891).	Typhus Fever. Weekly Statement, 1893. Jan. 28. Cases.	Feb. 18. Cases.	Mar. 11. Cases.	Mar. 18. Cases.	April 1. Cases.	Totals for 1st Quarter, 1893. Cases.	Deaths.	April 15. Cases.	May 6. Cases.	May 13. Cases.	Deaths.	May 20. Cases.	May 27. Cases.	Deaths.	June 3. Cases.	Deaths.	June 24. Cases.
London	4,232,118	[a]1	1	1	1	—	4	—	2	1	1	1	—	2	2	1	1	1
(*Administrative County*)	—	[b]1	1	1	1	1	5	—	1	1	1	—	1	2	—	1	—	1
W. District. Kensington	166,308	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—
W. District. Fulham	91,639	—	—	1	—	—	1	—	—	—	—	—	—	—	—	—	—	—
W. District. Hammersmith	97,239	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
W. District. Paddington	117,846	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—
W. District. Chelsea	96,253	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
W. District. St. George, Hanover Sq.*	78,599	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
W. District. Westminster	55,539	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
W. District. St. James, Westminster	24,995	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N. District. St. Marylebone	142,404	1	—	—	—	—	1	—	—	1	—	—	—	—	—	—	—	—
N. District. Hampstead	68,416	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N. District. St. Pancras	234,379	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N. District. Islington	319,143	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N. District. Hackney	229,542	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Central District. St. Giles and St. George, Bloomsbury.	39,782	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Central District. St. Martin-in-the-Fields	14,616	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Central District. Strand†	25,217	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Central District. Holborn‡	34,043	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Central District. Clerkenwell	66,216	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Central District. St. Luke, Middlesex	42,440	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Central District. London, City of§	37,583	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
E. District. Shoreditch	124,009	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
E. District. Bethnal Green	129,132	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
E. District. Whitechapel‖	74,420	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
E. District. St. George-in-the-East	45,795	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
E. District. Limehouse	57,876	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—
E. District. Mile End Old Town	107,592	—	—	—	1	—	1	—	—	—	—	—	—	—	—	—	—	—
E. District. Poplar	166,748	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District. St. Saviour, Southwark	27,177	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—
S. District. St. George, Southwark	59,712	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District. Newington	115,804	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District. St. Olave, Southwark	12,723	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District. Bermondsey	84,682	—	—	—	—	—	—	—	—	1	1	—	—	—	—	—	—	—
S. District. Rotherhithe	39,255	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District. Lambeth	275,203	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District. Battersea	150,558	—	1	—	—	—	1	—	—	—	—	—	—	—	—	1	1	—
S. District. Wandsworth	156,942	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District. Camberwell	235,344	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District. Greenwich	165,413	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District. Lewisham	92,647	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District. Woolwich	40,848	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District. Plumstead	88,539	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District. Port of London	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

[a] Totals of actual *notifications*.
[b] Totals furnished by the Metropolitan Asylums Board of *actual cases* after correction of returns and deduction of duplicate notifications.
* Including St. Peters, Westminster (population, 35). † Including Middle Temple (population, 95).

TYPHUS FEVER—*continued.*

Totals for 2nd Quarter, 1893.		Weekly Statement, 1893—*continued.*															Grand Totals for Year, 1893.		Sanitary Areas.
		July 15.	July 29.	Aug. 12.	Sept. 23.	Totals for 3rd Quarter, 1893.		Oct. 14.	Nov. 11.	Nov. 18.	Nov. 25.		Dec. 2.	Dec. 16.	Totals for 4th Quarter, 1893.				
Cases.	Deaths.	Cases.	Cases.	Cases.	Cases.	Cases.	Deaths.	Cases.	Cases.	Cases.	Cases.	Deaths.	Cases.	Cases.	Cases.	Deaths.	Cases.	Deaths.	
8	4	1	1	3	3	8	—	1	1	1	1	1	1	—	5	1	25	5	London.
8	—	*1*	*1*	*3*	*3*	*8*	—	*1*	*1*	*1*	—	—	*1*	*1*	*5*	—	*26*	—	(*Administrative County*).
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Kensington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Fulham.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Hammersmith.
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	Paddington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Chelsea.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George, Hanover Sq.*
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. James, Westminster.
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	St. Marylebone.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Hampstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Pancras.
—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	1	1	1	1	Islington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Hackney.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Martin-in-the-Fields.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Strand.†
—	—	—	—	—	1	1	—	—	—	—	—	—	—	—	—	—	1	—	Holborn.‡
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Clerkenwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Luke, Middlesex.
—	—	—	—	1	—	1	—	—	—	—	—	—	—	—	—	—	1	—	London, City of.§
—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	1	—	Shoreditch.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Bethnal Green.
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Whitechapel.‖
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George-in-the-East.
—	1	1	—	—	2	3	—	—	—	—	—	—	—	—	—	—	3	1	Limehouse.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Mile End Old Town.
1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	Poplar.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Saviour, Southwark.
—	—	—	1	—	—	1	—	—	—	1	—	—	—	—	1	—	2	—	St. George, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Olave, Southwark.
1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	Bermondsey.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Rotherhithe.
1	1	—	—	2	—	2	—	—	—	—	—	—	—	—	—	—	3	1	Lambeth.
—	—	—	—	—	—	—	—	1	1	—	—	—	—	—	2	—	3	—	Battersea.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Wandsworth.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Camberwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Greenwich.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Lewisham.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Woolwich.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Plumstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Port of London.

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121), Including Inner Temple (population, 96).

‖ Including Tower of London (population, 868).

No. 13.

App. A. No. 13. On the Causes of [illegible] by Mr. Power.

Interim Report on Inquiry by the Board's Medical Department respecting the Causes of the Lead Poisoning which has been referred to Public Water Supplies derived from Moorland Sources; by Mr. W. H. Power, F.R.S.

This investigation was entrusted to the Medical Department in September 1890. As was foreseen, it has proved both complex and tedious. And it is not yet completed. Nevertheless at the stage of the inquiry now reached, a brief statement of the methods of investigation adopted and of the facts so far collected may be of advantage. Later on it is proposed to report further, and in detail, on the subject.

To the date when this inquiry was ordered, the cause or causes of dangerous action on lead of natural waters had hardly been regarded as involving other than purely chemical problems. And upon this view, many moorland waters known to act vigorously upon lead had been subjected to examination; with the result that their possession of this property was referred, now to the presence, now to the absence, in them of one and another chemical substance. In this way, at one time the presence in a water supply of [illegible]; at another time deficiency in the water of lime or of silica, was put forward as sufficiently accounting for lead poisoning among the inhabitants of a district; and upon such bases of observation, now one, now another, *corrective* of the lead-dissolving power of moorland water was offered for adoption by water authorities. But so far, in regard at any rate of moorland waters, scarcely any attempt had, except by Dr. Sinclair White at Sheffield, been made at study of cause of their lead-dissolving property, in the sense of seeking to identify the primary antecedent conditions without which the effect would not result. In these circumstances it was determined that, as a matter of first instance, the Medical Department should undertake systematic study *in situ*, so to speak, on their gathering grounds, of the natural history of moorland waters, with a view to learning the conditions under which these waters *acquire their power* of dissolving lead. And, indeed, it was seen that upon knowledge of this class might rest the decision whether or not an elaborate and dubious process is to be applied to one or another water, in order to fit it for domestic use under the customary conditions of a community.

Accordingly a scheme of procedure comprising several separate steps or stages, was formulated as follows:—

I. Inquiry over a wide but defined area wherein public water supplies are largely derived from moorland gathering grounds, respecting the physical circumstances and conditions of delivery of each public water service, and as to whether or not lead poisoning had been observed in connexion therewith.

II. Differential examination, week by week throughout the year, of water samples freshly collected from each of several previously determined, and distinct, sources *on one and the same moorland gathering ground*. The gathering ground selected to comprise [illegible] which, from time to time, and in their aggregate, manifested pronounced ability to dissolve lead. The differential examination of the several weekly samples to include note of the direction, and the limits, of diversity of their chemical and bacterial [illegible], as well as of variations in the quality of these samples in regard to lead, with observation also as to how far this property was parallel with varintions in their chemical and bacterial features or with changes in their environment of seasonal or of meteorological sort.

III. Observation and testing under diverse conditions, seasonal and meteorological, of the waters from a great variety of moorland gathering grounds within the area scheduled for inquiry, with a view to ascertaining in what way and in what degree each such water supply, or part of it, differed as regards telluric and surface conditions, in reference to chemical and bacterial constituents, and in regard of ability to dissolve lead, from the standard or standards obtained as a result of research under heading No. II.

I.—Preliminary Inquiry in a Selected Area as to the Circumstances of Public Water Supplies in Reference to Lead Poisoning ascribed thereto.

The object of inquiry in the above sense was twofold: to ascertain from local sources of information within a wide area where lead poisoning was heard of, the amount of it that was being observed; and incidentally to obtain, broadly and generally, indication of the way or ways in which moorland supplies that were causing lead poisoning differed from those wherewith lead poisoning was not being associated. A series therefore of questions (Addendum A.), framed with a view of eliciting information on a variety of matters in the above connexion, was addressed to the Medical Officer of Health of every Sanitary District comprised within certain counties; the replies as they came to hand were next carefully studied and tabulated, and the results of analysis of the facts for each county duly summarised. Records of the data thus obtained, for the West Riding of Yorkshire by Dr. Barry, for Lancashire, Cumberland, and Westmorland by Mr. T. W. Thompson, are annexed as Addenda B. and C. to this report. Briefly the chief facts ascertained by them are as follow:—

West Riding of Yorkshire.—Area, 1,861,699 acres; number of inhabitants (estimated 1890)	2,536,766
Population obtaining public water service	2,086,187
Population obtaining public water service in the main from moorland sources	1,806,403
Population obtaining by public service, in the main from moorland sources, water *filtered* before delivery to consumers	692,326
Population obtaining by public service, in the main from moorland sources, water *not filtered* before delivery to consumers	1,114,077
Population obtaining by public service moorland water to which (or to portions of which) multiple cases of lead poisoning had in recent years been referred	711,202
Population obtaining *filtered* moorland water to which multiple cases of lead poisoning had in recent years been referred	34,061
Population obtaining *unfiltered* moorland water to which multiple cases of lead poisoning had in recent years been referred	677,141
Lancashire.—Area, 1,203,708 acres; number of inhabitants (estimated 1890–91)	4,020,328
Population obtaining public water service	3,756,539
Population obtaining public water service in the main from moorland sources	3,408,447
Population obtaining by public service, in the main from moorland sources, water *filtered* before delivery to consumers	1,203,713

Population obtaining by public service, in the main from moorland sources, water *not filtered* before delivery to consumers	2,204,734
Population obtaining by public service moorland water to which (or to portions of which) multiple cases of lead poisoning had in recent years been referred	132,759
Population obtaining *filtered* moorland water to which multiple cases of lead poisoning had in recent years been referred	Nil.
Population obtaining *unfiltered* moorland water to which multiple cases of lead poisoning had in recent years been referred	132,759

CUMBERLAND.—Area, 970,154 acres; number of inhabitants (estimated 1890–91)	265,623
Population obtaining public water service	174,409
Population obtaining public water service in the main from moorland sources	101,664
Population obtaining by public service, in the main from moorland sources, water *filtered* before delivery to consumers	10,881
Population obtaining by public service, in the main from moorland sources, water *not filtered* before delivery to consumers	90,783
Population obtaining by public service moorland water to which (or to portions of which) multiple cases of lead poisoning had in recent years been referred	Nil.
Population obtaining *filtered* moorland water to which multiple cases of lead poisoning had in recent years been referred	Nil.
Population obtaining *unfiltered* moorland water to which multiple cases of lead poisoning had in recent years been referred	Nil.

WESTMORLAND.—Area, 503,073 acres; number of inhabitants (estimated 1890–91)	66,538
Population obtaining public water service	27,324
Population obtaining water service in the main from moorland sources	21,516
Population obtaining by public service, in the main from moorland sources, water *filtered* before delivery to consumers	Nil.
Population obtaining by public service, in the main from moorland sources, water *not filtered* before delivery to consumers	21,516
Population obtaining by public service moorland water to which (or to portions of which) multiple cases of lead poisoning had in recent years been referred	Nil.
Population obtaining *filtered* moorland water to which multiple cases of lead poisoning had in recent years been referred	Nil.
Population obtaining *unfiltered* moorland water to which multiple cases of lead poisoning had in recent years been referred	Nil.

It thus appeared that of a population in these districts amounting to over six millions, some 70–80 per cent. were obtaining their drinking water by public service derived in the main from moorland sources;

that nearly two-thirds (64 per cent.) of the population thus supplied were having their moorland water delivered to them in unfiltered condition; and, that so far as lead poisoning by public water-supplies was being recognised in the counties in question, it was almost wholly confined to districts obtaining unfiltered moorland water. At the same time, it appeared that the amount of lead poisoning ascertained to be occurring differed widely in the several counties. Among West Riding districts lead poisoning referred to moorland water was abundantly recognised; in districts of Lancashire it was hardly heard of; while from Cumberland and Westmorland none was reported. How far this contrast in the amount of observed lead poisoning in the several counties was to be thought of as referable to intrinsic differences in moorland water as such, to precautionary measures public or private that had been taken, or to want of recognition of lead poisoning that was tending to occur, could not be judged of from the data supplied: so that it was seen that in these aspects the subject would require further study, which has accordingly been undertaken. As to this, it may be noted, at this stage, that want of recognition of lead poisoning has perhaps had not unimportant influence on the favourable report rendered of certain water supplies by the local officers; at any rate, the inhabitants of particular districts reported to the Department as altogether free from lead poisoning notwithstanding that they were served with unfiltered moorland water, have since been found suffering from the malady in question.

II.—Differential Examination, at Weekly Intervals and over a prolonged Period, of Waters of diverse sort from one and the same Moorland Gathering Ground.

This section of the inquiry was, as has been already indicated, concerned in submitting severally to frequent comparative test, those waters which, when combined together at a distance from their common moorland gathering ground, are apt to constitute public water supply; the object being to determine what are the seasonal modifications, chemical and bacterial, of each of such contributory waters; in what way and to what degree they differ at one and another time from each other as regards their inorganic and organic constituents; and how far diversity of their ability to dissolve lead is associated with season of the year and is at the same time parallel to observed differences in their chemical and bacterial characters. In this connexion two sorts of water common in moorland regions, namely, water issuing from springs in the soil, and rainfall-water accumulating on, or flowing over, or through, the peat substance, were seen to especially call for study; as also these two sorts of water in combination, and under circumstances, therefore, permitting interreaction of their several constituents; such water, for instance, as is afforded by a main stream, into which are received the contributory waters of a given moorland gathering ground.

For the purpose of establishing standards in the above sense of the behaviour of moorland waters, it appeared necessary that a laboratory should be acquired in the vicinity of the moorland gathering ground to be studied, so that the interval of time between the collection of weekly water samples and the testing of them in one and another way might be reduced within the smallest practicable limit. Hence in view of the circumstance that preliminary inquiry had shown moorland water-supplies having dangerous action on lead to be most numerous in the West Riding, and of the fact that comparative test, therefore, of many Yorkshire waters was likely to be called for, it was seen that both such

laboratory and such experimental gathering ground had better be in the county. Accordingly it was determined to accept the use at Settle of an existing laboratory, which was liberally placed at the disposal of the Department, and to seek in the neighbourhood of that place a small but well defined moorland area, typical of those larger areas forming Yorkshire gathering grounds, from which to obtain water of the sorts desired for observation. Settle, indeed, at this date (1891) offered exceptional advantages for the purposes in view. Dr. Barry had his official residence there, and thus was enabled to afford from time to time detailed supervision of the laboratory procedures. These were undertaken in the first instance by Mr. and Mrs. Atkinson, of Settle, afterwards by Dr. A. C. Houston.

Survey was next made, in association with Dr. Barry and Mr. T. W. Thompson, of certain moorland areas in the neighbourhood of Settle, and with the result that a gathering ground of the sort desired was selected at Burnmoor. It comprised a moorland tract from which water passing over or through the peat, and water also issuing from springs, converged to a particular stream, which in turn supplied a reservoir whence was derived the water supply of Bentham village. This water supply had been observed to possess from time to time acidity so pronounced as seriously to interfere with certain manufacturing processes carried on in the village, and also it was known to act on occasion vigorously on lead.

Upon the gathering ground thus selected the following waters were chosen for examination:—

(*a.*) The waters of certain springs representing the rain, which, falling on the gathering ground, had escaped prolonged contact with the peat soil, and had been chemically modified in passage through or between strata underlying the peat.

(*b.*) The waters of certain pools, representing rainfall-water that had remained in sustained contact with the peat and with vegetable organic matter living or dead.

(*c.*) The water of the stream descending to the service reservoir, and which represented mixture, differing in proportion from time to time, of waters (*a*) and (*b*).

Further, with a view of obtaining in regard to this gathering-ground concurrent meteorological and other necessary data, a rain gauge and earth thermometers were established thereon, and means were adopted for measuring from time to time the amount of water passing by way of the conjoined stream from the gathering ground to the reservoir referred to.

Finally, a skilled person was found to undertake the business of visiting the gathering ground early in the morning of Monday in each week for the purpose of recording the several meteorological and other facts respecting which information was desired, and for the purpose also of collecting water samples. These, along with record of the data in question, he was under obligation to deliver at the laboratory, at Settle, each Monday in the forenoon, so that the necessary examination of the water samples might follow as speedily as possible on their collection.

The differential examination to which it was determined to subject the Burnmoor water samples, comprised a week-by-week testing as follows:—

A. Their physical and chemical conditions in reference to—

(*a.*) Appearance in a 2 ft. tube; colour, turbidity, residue.

(*b.*) Reaction, with cochineal, methyl orange, and lacmoid.

(*c.*) Residue on evaporation; total, fixed, and loss on ignition.

(*d.*) Ammonia; free, and albuminoid.

(*e.*) Oxidised nitrogen; nitrates, and nitrites.
(*f.*) Oxygen required for oxidising organic matter
(*g.*) Chlorine.
(*h.*) Hardness; total, temporary, and fixed.
(*i.*) Dissolved oxygen.
(*j.*) Iron.
(*k.*) Acidity; quantitative estimation.
(*l.*) Ability to dissolve lead; as shown by the amount of lead taken up by samples under experimental conditions.

B. Their bacterial constituents—
(*a.*) The number of colonies per cubic centimetre.
(*b.*) The different kinds of micro-organisms to be obtained therefrom in pure culture.
(*c.*) The behaviour of these in various culture media.

In formulating the above scheme for different testing of various waters, the members of the Medical Department concerned in this inquiry had the advantage of the co-operation of Dr. Whitelegge, Medical Officer of Health of the West Riding County Council. This officer was at that time contemplating, and has since carried out on lines broadly parallel with those above indicated, study on behalf of his Authority of lead poisoning by public water supplies; and to him the Department is indebted for suggestion of the "lead-shot test" of the ability of a water to dissolve the metal in question. Details of this, as well as of the other methods of procedure adopted at the Settle laboratory, will be found in Addendum D. to this report.

Systematic observation thus undertaken of the Burnmoor (Bentham) waters was commenced in November 1891, and was continued weekly until the end of March 1893. In the course of this sustained scrutiny of samples from this gathering ground, much information bearing on the natural history of moorland waters was got together, and not a few of the facts recorded have an interest of their own, apart altogether from the particular question which was being studied. All the abundant information thus collected has been tabulated and charted, and in due course will be set out in detail in a further report. At present it will be enough to refer to certain only of the facts elicited, in a broad and general way and for the purpose of indicating the reason of some subsequent procedures.

Throughout the extended period during which the waters of the Burnmoor gathering ground were under examination, definite distinction was maintained between samples according as they were derived from the "pools" or from the "springs." These waters, *i.e.*, water from pools in the peat and water from springs issuing within the limits of the gathering ground, differed little at any time as regards their mineral constituents; moreover, both were very soft waters. Nevertheless, they differed widely and persistently in the circumstance that "pool" water was found almost without exception to be acid, whereas "spring" water was rarely found other than neutral to the tests employed; indeed, so far as "spring" water was on occasion found acid, this appeared due to access to the particular "spring" of rainfall water that had recently flowed over the peat surface. Further, and above all, "pool" waters and "spring" waters from this gathering ground differed in their ability to dissolve lead; "pool" water was invariably found to possess this property, sometimes in high degree; but "spring" water rarely possessed it, and then feebly only as compared with the other. Season appeared to have little effect in modifying the characters of these "spring" waters. "Peat-pool" water was, however, found to be

very much more acid in late summer and autumn than at other seasons, and at such times the ability of this water to dissolve lead was most pronounced.

The water of the stream descending from the gathering ground, and conveying to the service reservoir a mixture of "pool" and "spring" waters, was found to be, like the others, uniformly a very soft water, and little variation of its chemical characteristics was discoverable throughout the year. Not once during the time this conjoined water was under scrutiny did it exhibit, as it had done before investigation commenced, pronounced acidity and vigorous action on lead. Almost always it was found to be neutral in its reaction, and practically it was destitute of ability to dissolve that metal.

Bacteriologically the several waters, more particularly the "peat pool" waters, were at all seasons rich in micro-organisms. Such of these as were isolated directly from the waters and subjected to detailed study in a variety of artificial media were not observed to present features of particular interest.

As the outcome, therefore, of exact study of the natural history of different classes of waters from the given gathering ground, one class alone of such waters—that obtained from certain pools in the peat—was found to possess in marked degree, and persistently, ability to dissolve lead. And further, among a plurality of conditions, physical and chemical, appertaining to this particular class of water, one alone was found distinctly and uniformly parallel to its property of readily dissolving lead, namely, acidity of nearly every sample examined.* A series of diagrams annexed (Addendum E.) to this report serve to illustrate these facts.

These results, in so far as association of acidity with lead-dissolving power are concerned, afford, of course, no new knowledge. For it has again and again been noted in regard of moorland water supplies known to cause lead poisoning, that the samples of water acting thus vigorously on lead are commonly acid samples. As positive evidence therefore of direct association of these two conditions, the value of these Burnmoor observations mainly consists in the circumstance that they confirm this relation of acidity and lead dissolving ability *in regard of one and the same water over a considerable period of time*. But in their negative aspects the Burnmoor observations are of even greater value. They tend to indicate, by a plurality of determinations spread over many months, not only that the ability of a particular water to dissolve lead is closely associated with acidity of such water, but also that this action in regard of lead *is not to be* so associated with any other observed condition to which the water was liable. Upon all grounds, therefore, more exact study of the conditions determining acidity of moorland water was seen to be called for.

To this stage of the investigation the Burnmoor observations had been in the main conducted by Mr. and Mrs. Atkinson, under general superintendence by Dr. Barry; but early in 1893, Dr. Barry's presence was, for office reasons, continuously required in London, and, the services of Mr. and Mrs. Atkinson being now no longer available, some other arrangement had to be made. In these circumstances, the services of Dr. A. C. Houston were secured, for the purpose, *first*, of carrying out at the Settle Laboratory certain further observations of the Burnmoor

* Now and again, and as regards water that had been habitually found distinctly acid and possessed of marked ability to dissolve lead, a particular sample notwithstanding that its reaction inclined faintly to the alkaline side of neutrality, would still exhibit some feeble action on that metal.

waters; and, *secondly*, of making examination there of waters from a variety of Yorkshire gathering grounds, with a view to comparison, in one and another respect, of these waters with the standards already set up as a result of the procedures that have been described. Accordingly, Dr. Houston took up his residence at Settle early in August 1893, and has since continued to work there on lines determined on from time to time in conference with the Medical Department.

The chief business of Dr. Houston, at Settle, has been, up to the date of this report, observation of moorland waters in reference to inter-relations of their acidity and lead-dissolving property, along with study of the causes of acidity of these waters. But incidentally he has given attention also to another section of the lead-poisoning question; one, indeed, which, at an early stage of the Department's investigation, had given rise to difficulty, namely, certain observed differences in the *modus operandi* of one and the same water in regard of its action on lead. All these directions of work have involved comparison of other waters with Burnmoor water, and for this reason the results, so far obtained by Dr. Houston, will be most conveniently stated in this preliminary report under Heading No. III., which deals with lines of investigation not yet completed, and in regard of which, therefore, inferences are only provisional.

III. Comparison of Moorland Waters from a Plurality of Sources in Yorkshire with the Standards set up as the Result of previous sustained Observation of the Waters of a given Moorland Gathering Ground.

The several lines of work upon which Dr. Houston has engaged have necessarily interlaced at various points, and for this reason they have as far as practicable, been pursued concurrently. The sequence, therefore, in which the several sections of inquiry enumerated below are dealt with does not imply chronological sequence of procedure. It is adopted for reasons of convenience only:—

1. Difference in kind, of the "action" which is exercised by water on lead.
2. Correlation of acidity and lead-dissolving property in regard of moorland waters.
3. The source of the acidity of moorland waters.

Difference in kind of the "Action" which is exercised by Water on Lead.

As has been already indicated, at an early stage of this lead inquiry, it was seen to be requisite to take account of the fact that the term "action on lead," as applied to water samples, includes other action on this metal than the lead-dissolving process with which inquiry at Settle has been for the most part concerned. And similarly Dr. Houston has found, on a more extended basis of observation, that certain waters exhibit, when brought experimentally in contact with metallic lead in open vessels, not only ability to take up lead into solution, but ability to manufacture, as it were, a nearly insoluble lead compound, loosely attached to the lead and not shielding the metal from further attack of like kind. To the first-named property of a given water, the description "plumbo-solvent ability" is, Dr. Houston considers, conveniently applicable; as descriptive of the other process, which, in his view, is essentially erosion of the lead, he proposes the term "erosive ability."

In this connexion, and with a view to differentiating the conditions under which waters exhibit the one and the other property, Dr. Houston has made a number of interesting laboratory experiments, the results of which may be summarised thus:—

Pure rain-water and pure snow-water.—These were always found neutral in reaction, and none of the samples examined dissolved lead. All of them, however, eroded lead very vigorously, under laboratory conditions.

Distilled water.—A large number of observations showed that samples of "acid"* freshly-distilled water possessed great lead-dissolving power, but no power at all of eroding this metal. On the other hand distilled water that was "neutral"† in reaction had practically no ability to dissolve lead, though it eroded the metal vigorously, and in sustained fashion.

Moorland waters.—Moorland waters that are *acid* invariably possess ability to dissolve lead. At the same time they may, or they may not, erode this metal. Many moorland waters which dissolve lead to a considerable extent possess in regard of this metal no conspicuous erosive power. Other moorland waters both dissolve and erode lead in very decided fashion. Moorland *peat* waters are all, it would seem, not far removed from possession of the one or the other property, or of both properties. On the other hand moorland *spring* waters are usually free from ability to dissolve or to erode lead: such waters, indeed, when in admixture with peat water are capable of lessening or of inhibiting action of the latter on lead.

Natural waters other than rain or moorland waters.—Such waters (particularly those that have much temporary hardness) do not, as a rule, possess ability to dissolve or to erode lead. Many can, indeed, be experimentally shown to be remote from possession of either property; moreover, addition, even in small amount, of a "hard" water to distilled waters, or to acid moorland waters may, and usually does, remove from them ability to dissolve or to erode lead.

Dr. Houston's experiments suffice to show that distinction between "plumbo-solvency" and "erosion" may be of importance. It is not, it is true, certainly known whether in the actual circumstances of public water-supply erosion of the lead service pipes, with consequent suspension of an insoluble lead salt in the water, is able to occur. But having regard to the fact that, in the laboratory, a moorland water that erodes lead may continue to do so in sustained fashion, whereas (as will presently appear) a water that dissolves lead, commonly does so only so long as it retains acidity,—potential erosive quality of water distributed by public service may very possibly require to be guarded against even if the reaction of the water be not acid. Again, in common with the observed difference in kind of action of water on lead, certain of Dr. Houston's experiments tended to indicate the possibility (under laboratory conditions) of water losing its ability to dissolve lead, only to acquire, or increase in, erosive power; or at least to border more closely than before on possession of this quality. These questions deserve, and

* "Acid" in this connexion signifies a distillate the reaction of which tended to the *acid* side of neutrality when tested by delicate reagents such as are referred to at A. (*b.*), page 336.

† "Neutral" in this connexion signifies a distillate that inclined neither to the acid nor to the alkaline side of neutrality.

will receive, further study. In what follows, as in what has gone before in this report, liability of waters to *dissolve* lead is the chief subject of consideration.

Correlation of Acidity and Lead-dissolving Property in regard of Moorland Waters.

Among the earliest of his procedures after taking charge of the laboratory at Settle, Dr. Houston set to work to test, and has since from time to time continued to test, the characters exhibited by a number of waters from different moors in reference to the facts that had been observed at Burnmoor. The Burnmoor experiments, it will be remembered, indicated that ability of a water to dissolve lead is closely associated with acid reaction of the water, but with no other condition to which such water is subject. In this way a considerable number of separate waters, all of them of moorland origin, have been compared with each other and with the Burnmoor standard. And as a result, though some such waters do, while others do not, dissolve lead, waters of this class differed conspicuously in one other particular only, namely, as regards acidity. Those that dissolved lead were observed to possess an alkali-neutralising property; whereas those that did not dissolve lead were observed to possess an acid-neutralising property. There was no exception to this rule; whatever the direct source of the sample, whether from stagnant peat pool, from spring on gathering ground, from feeder to moorland reservoir, from service reservoir, or from town tap, this distinction was always maintained. And further, not only was there indication of association of acidity and lead dissolving property, but there was indication also of close relation between amount of acidity and vigour of solvent action on lead.* Direct parallelism of amount of acidity and vigour of lead-dissolving power was not, however, always found in regard of the same water when tested in these respects at different times; and different waters of equal acidity did not necessarily possess equal power of dissolving lead. Each water, indeed, appeared to possess its own standard of relation of lead-dissolving property to acidity and as the one quality varied naturally, or was artificially made to vary, so did the other, though not necessarily in direct proportion.

In illustration of the close association of lead-dissolving property and acidity under artificially contrived conditions, certain laboratory experiments by Dr. Houston may be here cited:—

Distilled water having ability to dissolve lead and possessing also alkali-neutralising property, lost on boiling both properties. So, too, many moorland waters lost, when boiled, much of their lead dissolving property and of their acidity. But certain moorland waters not only retained both properties after boiling, but manifested them in higher degree than before, to an extent indeed roughly corresponding to their concentration.

Distilled water having ability to dissolve lead and possessing also alkali-neutralising property, lost, when aërated, both properties. So, too, many moorland waters lost when thus dealt with some of their ability to dissolve lead, and lost, also, some of their acidity. But other moorland waters were not influenced in either respect by this process.

Distilled water having ability to dissolve lead and possessing also alkali-neutralising property, lost, when stored in bottles partially filled

* It is not to be inferred from the above statement that solvent action on lead of a water necessarily always disappears completely when the point of neutrality is reached. *See also* footnote to page 338.

and not stoppered, much of its ability to dissolve lead and also its property of neutralising alkali. So, too, many moorland waters similarly dealt with lost much of their ability to dissolve lead and much of their acidity. Other moorland waters, however, were hardly affected in either respect.

This section of the subject is receiving further study. Meanwhile, the fact as to association of lead-dissolving property and acidity is exhibited by diagrams (Addenda F. and G.) annexed to this report.

The Cause of the Acidity of Moorland Waters.

In proceeding to search for the source or sources of acidity of moorland waters, it appeared first of all important to determine the stage in its moorland history at which a water acquires acidity; whether, for instance, as regards water accumulated in pools in the peat, acidity is, so to speak, manufactured in the water *in situ*, or has been already contributed to it in the process of its passage there. Dr. Houston, therefore, instituted additional laboratory experiments in the following directions.

Acid waters from several separate moorland gathering grounds were tested as to the amount of acidity possessed by each immediately on collection, and were tested again in like manner after being dealt with in each instance in various ways:—

(*a.*) After *boiling*;
(*b.*) After *aëration*;
(*c.*) After keeping for differing periods of time in bottles *completely filled and stoppered*;
(*d.*) After keeping for differing periods of time in bottles *partially filled and not stoppered*;
(*e.*) After neutralising with sodium carbonate; thenceforward retaining, for differing periods of time, sections of such sample in bottles *partially filled and completely stoppered*; in bottles *partially filled and not stoppered*; and in bottles *completely filled and completely stoppered.*

As a result, Dr. Houston found that:—

Boiling usually greatly reduced the initial acidity. But certain waters were practically unaffected in this respect by boiling; indeed, sustained boiling of them increased their acidity to an extent corresponding to the concentration of the water.

Aëration usually slightly reduced the initial acidity. But some waters were altogether unaffected as regards their acidity by this process.

Keeping in bottles completely filled and completely stoppered in no instance gave rise to increase of acidity; usually there was slight diminution of that originally observed.

Keeping in partially filled bottles not stoppered usually diminished the acidity very greatly, and in some waters it almost disappeared. But there were waters in which the diminution of acidity was only slight after a considerable lapse of time.

Neutralising with sodium carbonate, with subsequent retention of the samples under different conditions of exposure to air: in no instance was there any re-development of acidity.

These observations appeared, all of them, to tend in one direction only. They seemed to indicate that, so far as acidity is concerned, the chemical history of the rain which after falling on a moorland accumu-

lates in depressions on the surface of the peat, is practically complete by the time that it has accumulated there; and that thenceforward such water is little likely *by processes set up within it*, to develop increase of acidity. The question, therefore, arose: What are the conditions to which rainfall on peat moorland is subjected, *antecedent* to its accumulations in pools there, that may be thought of as contributing acid quality to moorland water?

That *a something* is contributed by peat to water in sustained contact with it, or flowing over it or through it, had indeed been suggested by certain facts noted in regard of the Burnmoor series of observations; and, as a consequence, Dr. Houston had already commenced a week-by-week examination, chemical and bacteriological, of samples of *peat soil* selected by him on certain moorland gathering grounds. This peat soil he had, on a number of different gathering grounds, found to be, when moist, invariably acid. It occurred to him, therefore, at this juncture to further test his moorland waters the chemical history of which appeared to be complete, by bringing them once again into relation with the moorland, in so far as this might be done by means of a certain "peat essence" prepared by him for this purpose. And this he accomplished as follows:—

1. By adding, always in minute amount, freshly-collected samples of acid moorland waters to sterile (neutral) peat decoction.
2. By adding, in small amount, sterile (neutral) peat decoction to freshly-collected samples of acid moorland water.

The result was, to say the least, interesting. The neutral peat decoction, to which moorland water had been added, showed signs of bacterial growth, and developed in most instances acid reaction. So too, the moorland waters, to which peat decoction had been added, showed signs of bacterial growth, and usually increased in acidity. Thus, it was seen that if the agency dominant in producing the acid in question was contained in the *sterile* peat decoction, this agent must needs be of chemical not of biological nature; whereas, if contained in the moorland waters, it might be the one or the other. Hence followed the inference that failure of moorland waters under laboratory conditions to increase their acidity was due to the circumstance that they had become divorced from the peat; with the further suggestion, namely, that moorland water samples are apt to contain bacteria—no doubt derived from the peat—capable of generating acid when brought in relation with sterile peat decoction.

In these circumstances Dr. Houston instituted additional experiments in which, for the purpose of inhibiting bacterial processes in acid moorland water samples, alcohol as well as sterile peat decoction was added thereto. And he found that in every instance the water thus dealt with failed to develop additional acidity. With this indication that biological considerations were very possibly involved in satisfactory solution of the problem of acidity of moorland waters, Dr. Houston reverted somewhat hopefully to his study of the bacterial constituents of peat soil. His results, so far, in this connexion are briefly as follows:—

To separate samples of *distilled water* that was neutral in its reaction and which did not dissolve lead, there were added small amounts in each instance of *moist peat soil* from different selected gathering grounds. As a result every sample of distilled water developed in a short while acid reaction and was found to have acquired ability to dissolve lead.

To separate samples of *sterile (neutral) peat decoction* which did not dissolve lead, there were added minute amounts in each

instance of *moist peat soil* from different gathering grounds. As a result the samples of peat decoction always developed bacterial growth, and at the same time were usually found to possess acid reaction and ability to dissolve lead.

Gelatine plates inoculated with material from the above peat decoctions that had become acid as a result of addition to them of minute amounts of peat soil developed colonies of a variety of microbes.

Separated in pure culture and severally retransferred to other samples of sterile (neutral) peat decoction, the *majority* of the microbes that had been isolated failed to render this culture medium acid, or to confer on it ability to dissolve lead.

A *minority*, two in number, of the microbes thus isolated in pure culture *did*, when retransferred to sterile (neutral) peat decoction, render this medium acid, and they conferred on it at the same time ability to dissolve lead. Provisionally, Dr. Houston designates these microbes "O" and "Q."

Moist peat soil from a variety of gathering grounds when subjected to the process of plate culture yielded:—

(*a.*) A number of microbes which, when inoculated in pure culture into sterile (neutral) peat decoction, either did not grow therein; or, if they grew, produced no acid change in the medium.

(*b.*) Two microbes which, when inoculated into sterile (neutral) peat decoction, multiplied therein with considerable vigour, produced in the medium acid reaction, and conferred on it ability to dissolve lead.

These two microbes, which were found to be identical with "O" and "Q" above referred to, are still subjects of study by Dr. Houston. A provisional account of them furnished by him will be found in Addendum H. to this report.

ADDENDUM A.

SCHEDULE of QUERIES addressed to MEDICAL OFFICER OF HEALTH, SANITARY DISTRICT.

1. Estimated population (in 1890)?

2. Public water service, and how long established? (If more than one such service in district, please state facts.)
   - (*a.*) Name (or names) by which designated? (If from a company or corporate body supplying other places besides Sanitary District in question, please state facts, as far as known.)
   - (*b.*) Locality of gathering ground or gathering grounds, and distance from Sanitary District obtaining the supply?
   - (*c.*) Whether any of the water is filtered or otherwise "treated" before delivery to the Sanitary District? (If filtered or otherwise "treated," state composition of filter bed or nature of treatment adopted, and how long filtration or other treatment has been practised.)
   - (*d.*) Whether or not lead service pipes or lead cisterns are in use in the district?
   - (*e.*) Approximate number, in each instance, of inhabitants of the Sanitary District obtaining one or another public water supply?

3. Lead Poisoning.
   - (*a.*) In the past; at present; intermittent or continuous?
   - (*b.*) On the whole, increasing or diminishing, and extent of it?
   - (*c.*) Trades, if any, in the Sanitary District to which lead poisoning may in part be referred?

ADDITIONAL REMARKS.

App. A. No. 13.
Dr. Barry's Cases of Lead Poisoning by Mr. Power.

ADDENDUM B.

Records of Water Supplies in the Sanitary Districts of the West Riding of Yorkshire, collected as introductory to an investigation by the Medical Department of the local conditions affecting the Solubility of Lead by Water; by Dr. Barry.

In commencing the investigation which has been entrusted to the Department, of learning the conditions under which public water supplies become capable of dissolving lead pipes, with the result of causing lead poisoning among consumers of the water, it appeared desirable to have, for a part of the country from which this result is somewhat abundantly recorded, the experience of Medical Officers of Health; and I was instructed to make inquiry from the officers of the West Riding of Yorkshire as to the sources of the local water supplies, and as to any lead poisoning having this origin that may have come to their knowledge. Accordingly, a set of questions was addressed to these officers; and I have tabulated their answers and have made analysis of them. The records of the source of water supplies in the several sanitary districts of Yorkshire will probably be found to have interest apart from their special relation to lead poisoning.

The figures with respect to the area and population (1881) contained in columns 2 and 3 of the return have been, in every case, taken from the Census Report of 1881. But the figures with respect to the estimated population contained in column 4, with the information concerning the public water service contained in columns 5 to 20, have been in each case furnished by the Medical Officers of Health for the respective districts, whose names appear in the last column of the return.*

The total area to which the return refers comprises 1,861,699† acres, having in 1881 a population of 2,198,865† persons, and an estimated population in 1890 of 2,536,766 persons.

From an analysis of the return it appears that, of the total population dealt with, about 82 per cent. obtains water supply from public sources, whilst some 18 per cent. depends upon wells, springs, and other like sources for water supply.

The district with regard to which information is given comprises:—(*a*) five county boroughs, having an aggregate area of 66,262 acres, a population in 1881 of 943,593, and an estimated population in 1890 of 1,113,904 persons, or 44 per cent. of the whole; (*b*) 137 urban sanitary districts other than county boroughs, having an aggregate area of 337,746 acres, a population in 1881 of 881,293, and an estimated population in 1890 of 1,097,582 persons, or 40 per cent. of the whole; and (*c*) 30 rural sanitary districts, having an aggregate area of 1,457,691 acres, a population in 1881 of 373,979, and an estimated population in 1890 of 415,280 persons, or 16 per cent. of the whole.

A.—Water Supplies: Public and other.

In Table I. an analysis is given of the returns with respect to the five county boroughs, from which it will be seen that out of an estimated population of 1,113,904, no less than 1,110,968 persons, or 99·5 per cent. of the total, are reported to receive their water supply from public sources, leaving only 2,936 persons, or ·5 per cent., who are dependent on private sources of supply.

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* In view of the summary of these data which is given in the Tables IV. to XIV. it has not been considered requisite to reproduce here in full district returns appended to Dr. Barry's Memorandum.

† These figures differ to some extent from those given in the Census of 1881 for the West Riding of Yorkshire (the total area of the West Riding being now given in the Census being 1,858,000 acres with a population of 1,754,611). This difference is to be accounted for in the return of the figures with respect to portions of the rural sanitary districts of Selby, situate in the East Riding; of Great Ouseburn and Ripon, situate in the North Riding; of Goole and Thorne, situate in Lincolnshire; of Doncaster, situate in Nottinghamshire; of Rotherham, situate in Derbyshire; and of a portion of the Todmorden Urban District included until recently, in Lancashire.

TABLE I

SUMMARY of RETURNS with respect to the WATER SUPPLY of the FIVE COUNTY BOROUGHS in the West Riding of Yorkshire.

Name of Sanitary District.	Area in Acres.	Population, 1881.	Population estimated, 1890.	In Districts having Public Water Supply. Estimated Population		Population of Districts totally dependent on Private Sources of Supply.
				Served from Public Source.	Dependent on Private Sources.	
1.	2.	3.	4.	5.	6.	7.
Bradford - -	10,775	194,495	240,515	240,515	—	—
Halifax - -	3,768	73,630	82,500	82,500	—	—
Huddersfield -	10,496	81,841	94,253	94,253	—	—
Leeds - - -	21,572	309,119	363,799	363,700	99	—
Sheffield - -	19,651	284,508	332,837	330,000	2,837	—
	66,262	943,593	1,113,904	1,110,968	2,936	—

In Table II. an analysis is given of the returns with respect to the 137 urban sanitary districts, other than county boroughs, from which it will be seen that out of an estimated population of 1,007,582 persons resident in these districts, 829,180, or 60·5 per cent. of the total, are reported to receive their water supply from public sources leaving, 178,402 persons, or 39·5 per cent. who are dependent on private sources, of supply.

TABLE II.

SUMMARY of RETURNS with respect to the WATER SUPPLY of the 137 URBAN SANITARY DISTRICTS (other than County Boroughs) situate in the West Riding of Yorkshire.

Name of Sanitary District.	Area in Acres.	Population, 1881.	Population estimated, 1890.	In Districts having Public Water Supply. Estimated Population		Population of Districts totally dependent on Private Sources of Supply.
				Served from Public Source.	Dependent on Private Sources.	
1.	2.	3.	4.	5.	6.	7.
Altofts - -	1,837	3,172	3,700	3,700	—	—
Austonley - -	3,316	1,662	1,674	500	1,174	—
Baildon - -	2,605	5,430	6,000	6,000	—	—
Barkisland - -	2,421	2,102	2,000	—	—	2,000
Barnsley Borough -	2,386	29,790	34,500	34,500	—	—
Batley Borough -	2,039	27,505	31,000	31,000	—	—
Bingley Improvement District - -	909	8,972	10,000	10,000	—	—
Bingley Township -	9,407	9,465	10,000	8,014	1,986	—
Birkenshaw - -	1,000	2,699	2,700	2,700	—	—
Birstal - -	1,154	6,766	7,000	7,000	—	—
Brighouse - -	403	7,965	9,220	9,220	—	—
Burley in Wharfedale	3,133	2,550	2,750	2,600	150	—

TABLE II.—*continued.*

Name of Sanitary District.	Area in Acres.	Population, 1881.	Population, estimated, 1890.	In Districts having Public Water Supply Estimated Population		Population of Districts wholly dependent on Private Sources of Supply
				Served from Public Source.	Dependent on Private Sources.	
1.	2.	3.	4.	5.	6.	7
Calverley - -	2,074	2,246	2,500	2,000	500	—
Castleford - -	564	10,530	13,000	13,000	—	—
Charwell - -	489	1,973	2,000	2,000	—	—
Clayton - -	1,400	4,301	5,000	2,750	2,250	—
Clayton West -	1,140	1,435	1,435	1,435	—	—
Cleckheaton - -	1,755	10,653	13,000	13,000	—	—
Cumberworth -	1,185	1,471	1,471	—	—	1,471
Darton - -	4,358	6,014	7,400	6,500	900	—
Denby - -	2,885	1,559	1,559	—	—	1,559
Deighton - -	2,653	3,549	3,670	1,650	2,020	—
Dewsbury Borough -	1,468	29,637	33,200	33,200	—	—
Dodworth - -	1,916	2,989	3,000	3,000	—	—
Doncaster Borough -	1,691	21,139	26,750	26,750	—	—
Drighlington - -	1,136	4,214	4,100	4,100	—	—
Ecclesfield - -	1,220	7,037	8,000	8,000	—	—
Elland - -	1,483	8,278	9,500	9,500	—	—
Emley - -	3,556	1,289	1,290	—	—	1,290
Farnley Tyas -	1,785	614	630	400	230	—
Farsley - -	860	4,434	5,500	5,500	—	—
Featherstone - -	4,429	5,901	6,940	3,500	3,440	—
Flockton - -	1,108	1,180	1,320	—	—	1,320
Felstead - -	2,074	1,906	1,927	—	—	1,927
Gildersome - -	993	3,470	3,500	3,500	—	—
Gomar - -	1,593	7,653	9,300	5,700	3,600	—
Gomersal - -	1,100	3,988	4,000	4,000	—	—
Goole - -	1,002	10,418	16,600	13,000	3,600	—
Grasborough -	2,300	2,914	3,275	—	—	3,275
Greetland - -	409	4,166	4,650	1,020	3,630	—
Grimsley - -	1,554	3,706	4,050	2,700	1,350	—
Gunthwaite and Ingbirchworth -	2,057	405	405	—	—	405
Hanksworth - -	3,[illegible]	7,645	9,000	7,000	2,000	—
Harrogate Borough -	1,287	9,482	14,000	14,000	—	—
Haworth - -	560	4,816	4,940	3,840	1,100	—
Hebden Bridge -	357	5,057	6,300	3,000	3,300	—
Heckmondwike -	697	9,282	10,000	10,000	—	—
Hepworth - -	2,304	1,047	1,061	—	—	1,061
Hipperholme -	952	2,934	3,350	3,200	150	—
Holme - -	1,728	678	689	—	—	689
Honley - -	7,145	8,864	9,056	—	—	—
Ingbirchworth -	2,[illegible]35	3,[illegible]70	3,[illegible]85	3,[illegible]87	1,[illegible]98	—
Horbury - -	1,274	5,000	5,124	5,[illegible]24	—	—
Horsforth - -	2,891	6,446	7,000	6,750	250	—
Horsforth Swaine -	2,924	750	750	—	—	750
Huddersfield - -	1,780	1,516	1,723	1,600	123	—
Ilkley - -	1,[illegible]82	6,[illegible]11	6,600	4,[illegible]0	2,000	—
Ilkley - -	3,822	4,736	6,[illegible]00	6,[illegible]00	—	—
Keighley Borough -	1,742	25,127	29,000	29,[illegible]00	—	—
Kirkburton - -	1,[illegible]86	3,407	3,[illegible]10	2,[illegible]25	585	—
Kirkheaton - -	1,674	2,747	2,874	1,860	1,014	—
Knaresborough and Harrogate Improvement District -	481	5,000	5,000	5,000	—	—

TABLE II.—*continued.*

Name of Sanitary District.	Area in Acres.	Population, 1881.	Population estimated, 1890.	In Districts having Public Water Supply. Estimated Population		Population of Districts totally dependent on Private Sources of Supply.
				Served from Public Source.	Dependent on Private Sources.	
1.	2.	3.	4.	5.	6.	7.
Lepton	1,863	3,019	3,104	1,465	1,639	—
Linthwaite	1,320	6,068	7,300	2,135	5,165	—
Liversedge	2,130	12,757	14,200	13,300	900	—
Longwood	1,334	4,661	5,900	3,655	2,245	—
Luddenden Foot	530	2,891	3,000	2,000	1,000	—
Marsden	8,645	3,319	4,000	1,520	2,480	—
Meltham	4,692	4,529	5,000	3,750	1,250	—
Methley	3,492	4,074	4,600	—	—	4,600
Mexborough	1,293	6,319	7,200	3,600	3,600	—
Midgley	2,110	2,939	3,120	—	—	3,120
Mirfield	3,407	11,508	13,200	12,285	915	—
Monk Bretton	2,221	2,918	3,200	3,200	—	—
Morley Borough	2,765	15,011	19,873	19,873	—	—
Netherthong	795	936	949	—	—	949
Normanton	1,227	8,038	11,000	10,800	200	—
North Bierley	4,309	20,935	22,000	22,000	—	—
Northowram	1,479	3,294	3,294	1,100	2,194	—
Oakworth	11,905	5,762	5,900	1,507	4,393	—
Ossett Borough	3,105	10,957	12,500	12,500	—	—
Otley	2,370	6,806	8,000	8,000	—	—
Ovenden	4,504	7,487	7,500	3,250	4,250	—
Oxenhope	4,259	2,443	2,550	—	—	2,550
Penistone	1,133	2,254	2,800	2,400	400	—
Pontefract Borough	4,078	8,798	10,334	6,888	3,446	—
Pudsey	2,409	12,314	14,500	14,500	—	—
Queensbury	1,593	6,824	7,550	4,315	3,235	—
Quickmere	593	3,660	3,800	2,670	1,130	—
Rastrick	1,371	8,039	9,969	9,000	969	—
Ravensthorpe	358	4,364	5,000	5,000	—	—
Rawdon	1,559	3,407	3,500	2,675	825	—
Rawmarsh	2,578	10,179	13,000	13,000	—	—
Ripon City	1,580	7,390	7,720	7,500	220	—
Rishworth	6,548	1,110	1,100	—	—	1,100
Rotherham Borough	5,995	34,782	36,807	36,807	—	—
Rothwell	3,302	5,105	6,500	6,500	—	—
Sandal Magna	1,617	4,264	5,150	4,000	1,150	—
Scammonden	1,806	607	600	—	—	600
Scholes	763	1,182	1,089	—	—	1,089
Selby	3,760	6,057	5,910	5,910	—	—
Shelf	1,302	2,754	2,730	2,000	730	—
Shelley	1,568	1,687	1,687	395	1,292	—
Shepley	1,247	1,593	1,594	220	1,374	—
Shipley	1,406	15,093	18,500	18,000	500	—
Silsden	7,060	3,329	4,020	3,500	520	—
Skelmanthorpe	1,392	3,120	3,120	3,120	—	—
Skipton	4,245	9,091	11,700	11,700	—	—
Slaithwaite	3,170	3,882	5,600	—	—	5,600
Soothill Nether	562	5,240	5,700	5,700	—	—
Soothill Upper	1,897	5,155	5,800	5,500	300	—
South Crosland	1,834	3,048	3,150	2,360	790	—
Southowram	1,683	3,036	3,070	2,200	870	—
Sowerby	6,100	6,179	6,375	100	6,275	—
Sowerby Bridge	536	8,724	10,000	10,000	—	—

App. A. No. 13.

On the Causes of Land Purchase, by Mr. Power.

TABLE II.—*continued.*

Name of Sanitary District.	Area in Acres.	Population, 1881.	Population estimated, 1890.	In Districts having Public Water Supply. Estimated Population		Population of District totally dependent on Private Sources of Supply.
				Served from Public Source.	Dependent on Private Sources.	
1.	2.	3.	4.	5.	6.	7.
Soyland	4,270	3,467	3,600	—	—	3,600
Stainland with Old Lindley	2,335	4,933	5,200	—	—	5,200
Stocksbridge	4,334	4,660	6,000	4,860	1,140	—
Swinton	1,700	7,612	11,278	10,000	1,278	—
Thornhill	3,602	8,843	9,600	9,600	—	—
Thornton	2,132	6,084	6,084	4,500	1,584	—
Thurlstone	8,117	2,851	3,000	—	—	3,000
Thurstonland	2,106	997	1,040	—	—	1,040
Tickhill	489	1,684	1,700	—	—	1,700
Todmorden	15,690	23,862	25,750	2,910	22,840	—
Tong	2,657	5,591	7,000	6,800	200	—
Uppermill	135	1,384	1,500	1,000	500	—
Wakefield City	1,553	30,854	33,676	33,676	—	—
Warley	3,239	3,211	3,138	—	—	3,138
Wath	2,760	5,491	7,230	6,000	1,230	—
Whitley Upper	2,053	909	1,000	—	—	1,000
Whitwood	1,082	4,102	5,000	5,000	—	—
Wilsden	2,638	2,966	3,000	—	—	3,000
Windhill	780	6,732	7,300	7,000	300	—
Wombwell	3,851	8,451	11,000	11,000	—	—
Worsborough	3,779	8,443	9,000	8,700	300	—
Yeadon	1,723	6,534	7,693	7,693	—	—
	337,746	881,293	1,007,582	829,180	121,379	57,842

Upon further analysis of Table II., it appears that in the following 27 urban sanitary districts, having an aggregate estimated population of 57,842 persons, no public supply has hitherto been provided; and the inhabitants are wholly dependent on springs and wells, the water obtained from which is stated to be in many instances of doubtful quality:—Barkisland, Cumberworth, Denby, Emley, Flockton, Fulstone, Grassbrough, Gunthwaite and Ingbirchworth, Hepworth, Holme, Hoylandswaine, Methley, Midgeley, Netherthong, Oventhope, Rishworth, Scammonden, Schodes, Shatlewaite, Soyland, Stainland with Old Lindley, Thurlstone, Thurstonland, Tickhill, Warley, Whitley Upper, and Wilsden.

In the remaining 110 urban districts, which receive the whole or some portion of their water supply from public sources, and which have an aggregate estimated population of 950,559 persons, it is reported that there are still 121,379 persons, or 12·7 per cent., who are dependent on private sources of supply.

In Table III. an analysis is given of the returns with respect to the 30 rural sanitary districts, from which it will be seen that out of an estimated population of 329,884 persons resident in these districts, only 146,071, or 40 per cent. of the total, are reported to receive their water supply from public sources, having no less than 269,209 persons, or 60 per cent. of the total, dependent on private sources of supply.

Table III.

Summary of Returns with respect to the Water Supply of the 30 Rural Sanitary Districts situate in the West Riding of Yorkshire.

Name of Sanitary District.	Area in Acres.	Population, 1881.	Population estimated, 1890.	In Districts having Public Water Supply. Estimated Population		Population of Districts totally dependent on Private Sources of Supply.
				Served from Public Source.	Dependent on Private Sources.	
1.	2.	3.	4.	5.	6.	7.
Barnsley	17,875	20,616	24,600	15,000	9,600	—
Clitheroe (Yorkshire portion)	77,027	5,825	5,825	1,021	4,804	—
Doncaster	108,725	24,182	27,165	4,000	23,165	—
Goole	42,441	9,140	8,970	—	—	8,970
Great Ouseburn	60,627	11,955	12,036	2,000	10,036	—
Halifax	10,172	9,256	9,750	9,750	—	—
Hemsworth	34,831	11,106	14,732	—	—	14,732
Hunslet	6,583	5,687	6,462	4,900	1,562	—
Keighley	8,187	5,416	5,880	3,779	2,101	—
Knaresborough	39,468	8,153	8,323	—	—	8,323
Leeds	3,091	2,159	2,300	2,300	—	—
Pateley Bridge	75,063	8,944	9,500	500	9,000	—
Penistone	15,823	5,886	6,000	1,400	4,600	—
Pontefract	40,392	14,471	15,750	—	—	15,750
Ripon	71,640	9,057	9,057	2,090	6,967	—
Rotherham	37,729	14,087	18,978	5,000	13,978	—
Saddleworth	17,009	12,876	14,000	5,400	8,600	—
Sedbergh	52,665	4,079	4,260	1,350	2,910	—
Selby	53,224	9,758	9,500	—	—	9,500
Settle	151,942	13,800	14,970	6,448	8,522	—
Skipton	147,886	24,700	25,850	9,160	16,690	—
Tadcaster	72,865	23,955	26,316	1,450	24,866	—
Thorne	63,959	12,828	12,562	—	—	12,562
Todmorden	19,804	6,991	7,400	—	—	7,400
Wakefield	29,812	35,266	42,000	34,700	7,300	—
Wetherby	65,940	16,194	17,159	—	—	17,159
Wharfedale	51,452	7,190	8,815	2,083	6,732	—
Worksop (Yorkshire portion)	20,407	6,204	6,500	2,600	3,900	—
Wortley	54,103	31,848	38,720	30,460	8,260	—
York (West Riding portion)	6,949	2,350	1,900	680	1,220	—
	1,457,691	373,979	415,280	146,071	174,813	94,396

Upon further analysis of Table III., it appears that in the following eight rural sanitary districts, having an aggregate estimated population of 94,386 persons, no public supply has hitherto been provided:—Goole, Hemsworth, Knaresborough, Pontefract, Selby, Thorne, Todmorden, and Wetherby; while in the remaining 22 districts receiving a portion only of their water supply from public sources, and which have an aggregate estimated population of 320,884 persons, it is reported that no less than 174,813 persons, or 53·3 per cent., are dependent on private sources of supply. From the remarks of the Medical Officers of Health, it is apparent that many of these private supplies are eminently unsatisfactory both as regards quantity and quality.

B.—Public Water Supplies.

Each of the five county boroughs obtain their supplies of water from extensive moorland gathering grounds, and each of these corporations, besides supplying the districts under their immediate control, sell water to numerous other districts. Some notion of the extent to which these corporations trade in water may be obtained from a consideration of the fact, that of the 110 urban districts other than county boroughs, and of the 22 rural sanitary districts, which receive some portion of their supply from public sources, 54 of the urban, and eight of the rural districts, obtain the whole or a portion of their supply from the works of one or other of these bodies.

The municipal corporations of Dewsbury, Barnsley, and Wakefield (which are not county boroughs), whose water is obtained solely from moorland gathering grounds, also carry on considerable trade in water. They furnish supplies to 15 urban and to portions of three rural sanitary districts outside the limits of their boroughs.

Water is also supplied in common—but on a less extensive scale, and not always from moorland sources—to the whole or to portions of one or more additional districts (17* altogether) by the municipal corporations of Batley (*moorland*), Doncaster (*pasture and arable*), Keighley (*springs and moorland*), Ripon (*moorland*), and Rotherham (*springs and pasture*); by the local boards of Castleford (*coal measures*), and Yeadon (*meadow and pasture*); and by the Dearne Valley Water Company (*coal measures*).

Certain other districts or portions of districts (in all seven†) obtain water from the following works situate outside the West Riding:—Ashton-under-Lyne, Stalybridge, and Dukinfield Waterworks (*moorland*); Chesterfield Rural Sanitary Authority's Waterworks (*moorland*); Clitheroe Corporation Waterworks (*moorland*); Oldham Corporation Waterworks (*moorland*); and York Waterworks Company (*River Ouse*).

Of the total 137 sanitary districts in the West Riding having public water supply, only 29 (24 urban and five rural) obtain the whole of such service from sources within their own respective areas, and do not part with any portion of their supply to other districts. Of the 29 in question, 10 (all of them urban districts) obtain their supplies from moorland gathering grounds, 11 (six urban and five rural) from local springs, six (all urban) from deep wells, one (urban) from pasture and arable gathering ground, and one (urban) from a river.

C.—Lead Poisoning in Connexion with Public Water Supplies.

In making analysis of the information obtained with respect to lead poisoning, it will be necessary to deal with the various supplies seriatim, and in some detail.

(a.) *Bradford County Borough Waterworks.*

The water supply of the Bradford Corporation is almost wholly derived from high moorland, and is given by two separate services, known as the "High Level" and "Low Level" services respectively.

The sources of the supply to the low level service lie to the north of Bradford, in the valleys of the Rivers Aire and Wharfe. Before delivery to consumers this water is passed through a thickness of eight feet of filtering material composed of layers of sand and sandstone.

The sources of supply for the high level service lie to the west of Bradford, in the upland valleys of the Denholme Beck and River Worth, both tributaries of the River Aire. None of this water is submitted to processes of filtration before delivery to consumers.

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* Of these 17, one, getting water from Batley, is supplied also by Huddersfield [illegible] getting water from Keighley, is supplied also by Bradford; one, getting water from the Dearne Valley Co., is supplied also by Barnsley.

† Of the seven, one, getting water from Chesterfield, is supplied also by Sheffield.

In Table IV. a summary is given showing the estimated population of the several districts receiving their water supply from the Bradford high level and low level services respectively, together with the chief facts reported with respect to lead poisoning observed amongst the consumers of the water.

Table IV.

Bradford Corporation Waterworks.

District.	Estimated Population supplied from Bradford Corporation Waterworks.			Occurrence of Plumbism reported by the Medical Officers of Health for the several Districts as due to Water Supply.		
	Total.	High Level.	Low Level.	In the Past.	At Present.	Intermittent or Continuous.
1.	2.	3.	4.	5.	6.	7.
Bradford, U.	240,515	110,000	130,515	Yes	Yes	Intermittent.
Bingley Improvement District	3,000	—	3,000	—	—	—
Bingley, U.	1,000	1,000	—	—	—	—
Birkenshaw, U.	2,700	2,700	—	Yes	Yes	Intermittent.
Birstal, U.	7,000	7,000	—	Yes	Yes	Intermittent.
Calverley, U.	500	—	500	—	—	—
Clayton, U.	2,750	2,750	—	Yes	Yes	Not stated.
Cleckheaton, U.	13,000	2,250	10,750	—	—	—
Denholme, U.	375	375	—	Yes	Yes	Not stated.
Drighlington, U.	4,100	4,100	—	Yes	Yes	Intermittent.
Eccleshill, U.	8,000	8,000	—	Yes	Yes	Intermittent.
Farsley, U.	5,500	—	5,500	—	—	—
Gildersome, U.	3,500	3,500	—	Yes	Yes	Intermittent.
Gomersal, U.	4,000	4,000	—	Yes	Yes	Intermittent.
Hunsworth, U.	1,600	—	1,600	—	—	—
Idle, U.	4,600	2,100	2,500	—	—	—
Liversedge, U.	13,300	4,700	8,600	—	—	—
North Bierley, U.	22,000	22,000	—	Yes	Yes	Continuous.
Pudsey, U.	14,500	14,500	—	Yes	Yes	Intermittent.
Queensbury, U.	4,315	4,315	—	Yes	—	Intermittent.
Shelf, U.	2,000	2,000	—	Yes	—	Intermittent.
Silsden, U.	3,500	—	3,500	—	—	—
Skipton, R. (Addingham)	1,300	—	1,300	—	—	—
Thornton, U.	4,500	4,500	—	—	—	—
Tong, U.	6,800	6,800	—	Yes	Yes	Intermittent.
Windhill, U.	7,000	1,000	6,000	—	—	—
	381,355	207,590	173,765			

From the above table it will be seen that water is supplied from the Bradford Corporation Waterworks to the borough of Bradford, and as well to portions of 25 sanitary districts (24 urban and 1 rural) outside the limits of the borough.

The total population so supplied is estimated at 381,355 persons, and of these, it is estimated that 173,765 receive their supply from the low level, and 207,590 from the high level service. Amongst the consumers of the low level water, whether resident inside or outside the borough of Bradford, no case of plumbism due to water has been observed. But on the other hand, amongst the consumers of the high level water, lead poisoning is reported to have been more or less extensively prevalent, in Bradford, Birkenshaw, Birstal, Clayton, Denholme, Drighlington, Eccleshill, Gildersome, Gomersal, North Bierley, Pudsey, Queensbury, Shelf, and Tong. In one district (the Cross-flatts portion of the Bingley Township Urban Sanitary District), where 1,000 persons receive their supply solely from this high level service, and in the

following urban districts—Checkheaton, Idle, Liversedge, and Windhill—supplied from both high and low level services, no cases of plumbism have been observed. At Thornton, also, no cases of plumbism have been observed; but here the high level water is, prior to delivery to consumers, mixed with spring water obtained from the millstone grit.

In the districts where the water supply is reported to have given rise to lead poisoning, such poisoning is stated to have been continuous in character in one district only, namely, North Bierley. In two districts, Clayton and Denholme, no observations with respect to this point have apparently been made; whilst in the remaining 11 districts lead poisoning is stated to have been intermittent in character.

(b.) *Halifax County Borough Waterworks.*

The water supply of the Halifax Corporation is derived from moorland situate in the upland valleys of the Rivers Hebble, Luddenden, Widdop, and Greave. This water is not submitted to any process of filtration prior to delivery to consumers.

In Table V. a summary is given showing the estimated population of the several districts receiving their water supply from these waterworks, together with the chief facts reported with respect to lead poisoning observed amongst the consumers of the water.

TABLE V.

HALIFAX CORPORATION WATERWORKS.

District.	Estimated Population supplied from Halifax Corporation Waterworks.	Observations by Medical Officers of Health with respect to Lead Poisoning due to the Water Supply.
1.	2.	3.
Halifax, U. - -	82,500	No recent lead poisoning. *See* text.
Brighouse, U. -	9,220	None observed.
Elland, U. - -	9,500	,,
Greetland, U. -	1,920	..
Hebden Bridge, U. -	3,000	..
Hipperholme, U. -	3,200	..
Horbury, U. -	5,724	..
Northowram, U.	1,100	,,
Ovenden, U. -	4,250	40 cases of lead poisoning in 1884.
*Rastrick, U. -	6,000	None observed.
Soothill Upper, U. -	5,000	..
Southowram, U. -	2,250	..
Sowerby, U. - -	100	..
Sowerby Bridge, U. -	10,000	..
Todmorden, U. -	9,000	..
Halifax, R. - -	8,250	..
	163,164	

* The water is mixed before delivery to consumers with spring water rising in sandstone.

From the above table it will be seen that water is supplied from the Halifax Corporation Waterworks to the borough of Halifax and to portions of 15 sanitary districts (14 urban, one rural) outside the limits of the borough. The total population so supplied is estimated at 163,164 persons. Amongst the consumers of the Halifax water, no cases of plumbism have been observed during the last five or six years, but the Medical Officer of Health reports that a number of cases occurred in that borough in 1880-81 when the Rag[illegible] Head reservoir was first brought into use, that suspicion was then thrown upon some materials used in the construction of this reservoir, in consequence

of which the reservoir was cleansed and cemented; and that since then no further cases of lead poisoning, attributable to water supply, have been reported within the borough. The Medical Officer of Health for Ovenden states that in 1884, some 40 cases of plumbism occurred in the Ovenden District amongst consumers of the Halifax water, but, since that date, no new cases have apparently been observed.

(c.) *Huddersfield County Borough Waterworks.*

The water supply of the Huddersfield Corporation is derived from gathering grounds situate on lofty hills lying at a distance of 2¾ to 7 miles south-west of Huddersfield. It is given in three separate services, known as the "Longwood," "Wessenden," and "Blackmoorfoot" supplies respectively. The sources of supply to the Longwood and Wessenden services are chiefly springs, although some of the water for these services is also obtained from gathering grounds. The Blackmoorfoot supply is wholly obtained from moorland. None of the Huddersfield water is submitted to any process of filtration prior to delivery to consumers.

In Table VI. a summary is given showing the estimated population of the several districts receiving their water supply from the Huddersfield Works, and, as far as possible, distinguishing the separate sources of supply. The chief facts reported with respect to lead poisoning, observed amongst the consumers of the water, are also given.

Table VI.

Huddersfield Corporation Waterworks.

District.	Estimated Population supplied from the Huddersfield Corporation Waterworks.				Occurrence of Plumbism reported by the Medical Officers of Health for the several Districts, as due to Water Supply.		
	Total.	Longwood, Wessenden, and Blackmoorfoot.	Wessenden only.	Wessenden and Blackmoorfoot.	In the Past.	At Present.	Intermittent or Continuous.
1.	2.	3.	4.	5.	6.	7.	8.
Huddersfield, U.	94,253	48,733	8,862	36,658	Yes	To a small extent.	Intermittent.
Golcar, U.	4,150	—	4,150	—	Rarely	—	"
Honley, U.	2,935	—	—	2,935	—	—	
Kirkburton, U.	2,925	—	—	2,925	Yes; four cases in the last eight years.	—	—
Kirkheaton, U.	1,860	—	—	1,860	—	—	—
Lepton, U.	1,465	—	—	1,465	—	—	—
Linthwaite, U.	2,135	—	—	2,135	—	—	—
*Longwood, U.	3,655	3,655*	—	—	—	—	—
Marsden, U.	1,520	—	1,520	—	—	—	—
Mirfield, U.	12,285	—	—	12,285	Yes	Yes	Continuous.
Shelley, U.	395	—	—	395	—	—	—
Shepley, U.	220	—	—	220	—	—	—
South Crosland, U.	2,360	—	—	2,360	Occasionally	Occasionally	Intermittent.
	130,158	52,388	14,532	63,238			

* This district is now (1891) included within the borough of Huddersfield. It receives its water supply partly from Wessenden and partly from Longwood.

From the above table it will be seen that water is supplied from the Huddersfield Corporation Waterworks to the borough of Huddersfield, and to portions

of 12 urban sanitary districts outside the limits of the borough. The total population so supplied is estimated at 130,158 persons, and of these it is estimated that 48,733, all living within the borough, are supplied with water from all three sources; that 5,655, all living in Longwood, are supplied with water from Longwood and Wessenden; that 14,532 (8,862 within, and 5,670 outside, the borough) receive their supplies solely from the Wessenden source; and that 63,238 (36,658 within, and 26,580 outside, the borough) receive their supply from the Wessenden and Blackmoorfoot sources.

No cases of plumbism are reported to have been observed amongst persons obtaining their supply solely from the Wessenden source, but cases of lead poisoning are reported to have occurred amongst persons resident within the borough, who receive their supply from the three sources conjointly, and, to an alarming extent, amongst the inhabitants of Marsden, the supply of which district is obtained from the Wessenden and Blackmoorfoot sources. In two other districts, namely, Kirkburton and South Crosland, receiving water from Wessenden and Blackmoorfoot sources, occasional cases of plumbism have been observed; but in none of the other districts, namely, Linthwaite, Kirkheaton, Lepton, Shelley, Shepley, and Honley, supplied from these two sources, have any cases been noted.

(d.) *Leeds County Borough Waterworks.*

The water supply of the Leeds Corporation is derived from moorland gathering grounds in the upland valley of the River Washburn, a tributary of the River Wharfe, situate 17 miles north-west of Leeds. Before delivery to consumers, this water is passed through filtering material 3 ft. 6 ins. in thickness, of which the upper two feet is composed of fine river sand. A list of the districts supplied from the Leeds Corporation Waterworks is given in Table VII.

TABLE VII.

LEEDS CORPORATION WATERWORKS.

District.	Estimated Population supplied from Leeds Corporation Waterworks.	Observations by Medical Officers of Health with respect to Lead Poisoning due to the Water Supply.
1.	2.	3.
Leeds, U. - - -	363,700	No cases of plumbism observed.
Churwell, U. - - -	2,000	,, ,, ,,
Morley, U. - - -	19,873	,, ,, ,,
Rothwell, U. - - -	6,500	,, ,, ,,
Hunslet, R. (Oulton-with-Woodlesford) - -	2,700	,, ,, ,,
Leeds, R. - - -	2,300	,, ,, ,,
Tadcaster, R. (Crossgates) -	750	,, ,, ,,
Wharfedale, R. (Leathley and Arthington) - -	300	,, ,, ,,
	398,123	

From Table VII. it will be seen that water is supplied from the Leeds Corporation Waterworks to the borough of Leeds and to portions of seven sanitary districts (three urban, four rural) outside the limits of the borough. The total population so supplied is estimated at 398,123 persons.

No cases of lead poisoning have been observed amongst the consumers of this water.

(e.) *Sheffield County Borough Waterworks.*

The water supply of the Sheffield Corporation is derived from moorland gathering grounds, and is given in two separate services known as the "high level" and "low level" supplies respectively. The high level supply is obtained from gathering grounds at Redmires, situate some five or six miles west of Sheffield. The low level supply is obtained from gathering grounds situate in the upland valleys of the Rivers Rivelin and Locksley, both tributaries of the River Don. These gathering grounds lie immediately to the north of the gathering grounds for the high level service. None of the water is submitted to any process of filtration, but since March 1890 special treatment has been applied to the high level water prior to its delivery to consumers. This treatment has consisted of the addition of as much finely powdered chalk to the water as it is capable of dissolving.

In Table VIII. is given a list of the districts (situate in the West Riding), with their respective estimated populations, supplied from the Sheffield Waterworks, together with notes on lead poisoning where such has been observed by the Medical Officers of Health.

TABLE VIII.

SHEFFIELD CORPORATION WATERWORKS.

District.	Estimated Population supplied from Sheffield Corporation Waterworks.			Occurrence of Plumbism reported by the Medical Officers of Health for the several Districts as due to Water Supply.		
	Total.	High Level.	Low Level.	In the Past.	At Present.	Intermittent or Continuous.
1.	2.	3.	4.	5.	6.	7.
Sheffield, U. -	330,000	110,000	—	Yes	To a less extent.	Intermittent.
	—	—	220,000	None	None.	—
Handsworth, U. -	7,000	7,000	—	—	—	—
*Rotherham, R. -	3,000	3,000	—	—	—	—
Wortley, R. -	25,260	20,760	—	Yes	None.	—
	—	—	4,500	None	None.	—
	365,260	140,760	224,500			

* Tin-lined pipes adopted in this district along with Sheffield water service.

From the above table it will be seen that water is supplied from the Sheffield Corporation Waterworks to the borough of Sheffield and to portions of three sanitary districts (one urban, two rural) situate in the West Riding of Yorkshire, outside the limits of the borough. The population so supplied is estimated at 365,260 persons, and of these it is estimated that 140,760 receive their supply from the high level, and 224,500 from the low level service. With respect to these figures it must be, however, noted that the area of supply of the one and the other service is being continually changed and that consequently the above estimates must be regarded as only roughly approximate. Amongst the consumers of the low level water, whether resident inside or outside the borough of Sheffield, no case of plumbism due to water supply has been observed. On the other hand, numerous cases of plumbism attributable to the water supply have been observed amongst the consumers of the high level service resident in Sheffield and in the rural sanitary district of Wortley. No cases of plumbism have apparently been observed amongst consumers of the high level water living in either the Handsworth Urban or in the Rotherham Rural Sanitary Districts; but in the latter, it is to be noted, that tin-lined service pipes are compulsory. In those portions of the area of high

level service where the water is said to have given rise to lead poisoning is stated to have been intermittent in character. By the courtesy of Dr. Thomson, medical officer of health for Sheffield, I am enabled to append to Appendix B.* a list of all the deaths certified to have been due to plumbism registered in the borough of Sheffield from 1871 to 1884, inclusive. From this list it will be observed that in recent years local cases of lead poisoning have occurred in which the poisoning has been attributed to drinking the Redmires (high level) water.

[In addition to the population living in the West Riding supplied with water from the Sheffield Works, it is estimated that nearly 7,000 persons resident in the Ecclesall Bierlow Rural District, obtain a portion of their water supply from that source. The greater proportion of these are said to be supplied from the high level service. Amongst the populations stated as lead poisoning due to the water supply are said to have occurred fatal cases as under:]

(f.) *Barnsley Corporation Waterworks.*

The water supply of the Barnsley Corporation is derived from surrounding gathering grounds situate at Ingbirchworth, near Penistone, about nine miles west of Barnsley. The water has, for the past 14 years, been filtered through sand and gravel, and for the last three years through charcoal, sand, and gritstone each 2 ft., and through a layer of broken limestone, 1 ft. 6 ins. in thickness.

A list of the districts supplied with water from the Barnsley Corporation Waterworks, together with their estimated populations, is given in Table IX.

Table IX.

Barnsley Corporation Waterworks.

District.	Estimated Population supplied from Barnsley Corporation Waterworks.	Observations by Medical Officers of Health, with respect to Lead Poisoning due to the Water Supply.
1	2	3
Barnsley, U. - - -	34,500	Five cases in Barnsley and one in Dearnside reported to have died from lead poisoning, in former years, the lead service pipes were of unusual length.
Darton, U. - -	6,000	No cases of plumbism observed.
Dodworth, U. - -	2,000	Not given.
Monk Bretton, U. - -	2,000	No cases of plumbism observed.
Worsbrough, U. - -	8,700	" " "
Ecclesfield, R. (Ardsley and Tingley) - -	6,000	" " "
Penistone, R. (Silkstone) -	1,000	" " "
	60,200	

From the above table it will be seen that water is supplied by the Corporation of Barnsley, and to portions of six surrounding districts (Darton, Dodworth, Monk Bretton, Worsbrough, Ecclesfield, and Penistone), which contain (by estimate, 1884) a total population of 60,200 persons. A certain number of cases of plumbism, amongst persons using this water, were observed in 1885 and in 1886 in Barnsley and Darton; but in each of the cases, the Medical Officer of Health reports that the lead service pipes were of unusual length.

(g.) *Bolton Corporation Waterworks.*

The water supply of the Bolton Corporation is derived from moorland gathering grounds situate near to Rivington, in the township of Noblethorpe,

* Not reproduced.

some 30 miles south-west of the borough. The water is not filtered prior to its delivery to consumers.

It is estimated that 31,000 persons living in the borough of Batley receive their supply from this source, and 152 persons in Honley are likewise reported to obtain their supply from the Batley Works.

The Medical Officer of Health for Batley reports the constant prevalence in the borough of lead poisoning amongst the consumers of the water, in fact, to such an extent does this exist, that he considers himself justified in stating that fully one-half of the patients he sees in his practice, suffer more or less from the water supply. No cases of plumbism have been observed amongst the consumers of the Batley water living in Honley.

(h.) *Castleford Local Board Waterworks.*

The water supply of Castleford is obtained from a well sunk in the coal measures to a depth of 50 feet. The water is not submitted to any process of filtration prior to delivery to consumers.

It is estimated that 13,000 persons living in the urban sanitary district of Castleford receive their supply from this source, and 700 persons resident in Allerton-Bywater, in the Tadcaster Rural Sanitary District, are also reported to obtain their supply from the Castleford Works. No cases of plumbism attributable to the water supply have been observed amongst the consumers of this water.

(i.) *Dearne Valley Waterworks Company.*

The water supply of the Dearne Valley Company is derived from a deep well sunk in the coal measures near to Wombwell. The water is not submitted to any process of filtration before delivery to consumers.

It is estimated that the Company furnishes water to 11,000 persons living in the urban sanitary district of Wombwell, and to 8,000 persons living in Nether Hoyland and Darfield, in the rural sanitary district of Barnsley. No cases of plumbism attributable to water supply have been observed amongst the consumers of this water.

(k.) *Dewsbury and Heckmondwike Water Board.*

The water furnished by the Dewsbury and Heckmondwike Water Board is obtained from moorland gathering ground situate at Durnford Bridge, about 16 miles south-west from Dewsbury. The water is not submitted to any process of filtration prior to delivery to consumers. A list of the districts supplied with water from this source, with their estimated populations, and notes with respect to lead poisoning, are given in Table X.

Table X.

Dewsbury and Heckmondwike Water Board.

District.	Estimated Population supplied from the Dewsbury and Heckmondwike Water Board.	Observations by Medical Officers of Health with respect to Lead Poisoning due to the Water Supply.
1.	2.	3.
Dewsbury, U. -	33,200	Four cases in 1889.
Clayton West, U. -	1,435	Four cases in February 1891.
Heckmondwike, U. -	10,000	—
Ossett, U. - -	12,500	A few instances where lead service pipes were found of unusual length.
Ravensthorpe, U. -	5,000	—
Skelmanthorpe, U. -	3,120	—
Soothill Nether, U. -	5,700	One case where lead service pipe was of unusual length.
	70,955	

From the above table it will be seen that water is supplied by the Dewsbury and Heckmondwike Water Board to the borough of Dewsbury, to the local board district of Heckmondwike, and to portions of five urban sanitary districts outside the limits of the above-named districts. The total population so supplied is estimated at 70,955.

Amongst the consumers of the Dewsbury water, four cases of plumbism, attributable to the water, are reported to have occurred in the borough of Dewsbury in 1889, and four more cases in the Clayton West Urban District in February of the present year (1891). A few instances have also been observed, where the lead service pipes have been of unusual length, in the borough of Ossett and in the Clayton West and Soothill Nether Urban Districts; whilst, in the remaining urban districts of Heckmondwike, Ravensthorpe, and Skelmanthorpe, no cases of plumbism, due to the water, have been brought to the knowledge of the respective Medical Officers of Health.

(l.) *Doncaster Corporation Waterworks.*

The water supply of the Doncaster Corporation is obtained from gathering ground consisting chiefly of pasture, with some arable land, overlying magnesium limestone, in the parishes of Conisborough and Rewenfield, about nine miles south-west of Doncaster. The water is passed through filtering material of sand and gravel, 5 ft. in thickness, prior to its delivery to consumers.

It is estimated that 26,750 persons living in the borough of Doncaster receive their supply from this source, and 4,000 persons living in Wheatley, Balby, and Hexthorpe, in the Doncaster Rural Sanitary District, are also reported to obtain their supply from the Doncaster Works.

No cases of plumbism attributable to the water supply have been observed amongst the consumers of this water.

(m.) *Keighley Corporation Waterworks.*

The water supply of the Keighley Corporation is derived partly from springs, and partly from moorland gathering grounds, and is given in four separate services, known as the (*a*) Calversyke, (*b*) Sheddles, (*c*) Park Lane, and (*d*) Green House supplies, respectively. Of these, (*a*), (*c*), and (*d*) are derived from springs, all situate within the borough, and (*b*) from gathering grounds on the Stanbury and Trawden Moors, situate at a distance of from seven to eight miles west of Keighley.

None of the supplies obtained from springs are filtered or otherwise treated before delivery to consumers. But the Sheddles water, which forms the chief supply for the borough of Keighley, is filtered through coke and fine sand, and is further treated before entering the Keighley supply reservoir by being passed through a conduit 120 yards long, filled with Derbyshire limestone. In addition powdered lime is daily contributed to the water in the conduit.

It is estimated that a population of 1,700 persons, all resident within the borough, obtain their water from supplies (*a*), (*c*), and (*d*); and, similarly, it is estimated that 34,061 persons resident in Keighley and in portions of two urban sanitary districts outside the limits of that borough, are supplied with Sheddles water. A list of these districts is given below:

District.		Estimated Population.
Keighley Borough - - - - - - - -		27,960
Bingley Township, U. (part of), (Cross Roads and Wesley Place)		4,594
Oakworth, U. (part of) :—		
Oakworth village - - - - -	1,206	
Utley, High and Low - - - - -	301	
		1,507
		[illegible]

Amongst the consumers of this water resident in Keighley, cases of lead poisoning were formerly very frequent; but since the water has been treated as stated above, isolated cases only have been observed. In Cross Roads and Wesley Place (Bingley Township, U. and in Oakworth village (Oakworth, U.), cases of lead poisoning have been observed from time to time; and with respect to these districts, it is to be noted that their water is drawn direct from the main conduit, and consequently, is not submitted to any process of filtration or treatment prior to its delivery to these places. In High and Low Utley (Oakworth, U.) no cases of lead poisoning attributable to water have been observed; but to this portion of the district the water is delivered from the Keighley service reservoir after it has been submitted to the special treatment already referred to. The lead poisoning is stated to have been intermittent in character in all the districts affected.

The Medical Officer of Health for Keighley reports that the greater number of cases occur in the months of March and August.

(n.) *Ripon Corporation Waterworks.*

The water supply of the Ripon Corporation has, since 1888, been obtained from moorland gathering grounds situate at Lumley Moor, seven miles from the city. The water is filtered through layers of sand, 2 ft. 6 ins., rubble, 2ft., and large stones, 1 ft. 6 ins. in thickness, prior to delivery to consumers.

It is estimated that 7,500 persons living in the city of Ripon receive their supply from this source, and 500 persons, living in Bishopton, Urebank, Sharow, Studley Royal, and Lindrick, in the Ripon Rural Sanitary District, are also reported to obtain their supply from the Ripon Works.

No cases of plumbism attributable to the water supply have, up to the present time, been observed amongst the consumers of the water.

(o.) *Rotherham Corporation Waterworks.*

The water supply of the Rotherham Corporation is obtained partly from springs and partly from a gathering ground situate at Dalton, $3\frac{1}{2}$ miles south-east of the borough.

The water is filtered through sand and gravel prior to its delivery to consumers. It is estimated that 36,807 persons, living in the borough of Rotherham, receive their supply from this source, and 13,000 persons living in the Rawmarsh Urban Sanitary District are reported to obtain their water supply from these works.

No cases of plumbism, attributable to the water supply, have been observed amongst the consumers of the Rotherham water.

(p.) *Wakefield Corporation Waterworks.*

The water supply of the Wakefield Corporation has, since 1888, been obtained from moorland gathering grounds situate at Rishworth, some 26 miles west-south-west from Wakefield.

The water has not hitherto been submitted to any process of filtration or treatment prior to its delivery to consumers.

In Table XI. a summary is given, showing the estimated populations of the several districts receiving their water supply from these works together with notes as to the occurrence of lead poisoning amongst consumers.

App. A. No. 16
In the Appendix to the Report of Mr. Power.

Table XI.

Wakefield Corporation Waterworks.

District.	Estimated Population supplied from Wakefield Corporation Waterworks.	Occurrence of Plumbism reported by the Medical Officers of Health for the several Districts as due to Water Supply.		
		In the Past.	At Present.	Intermittent or Continuous.
1.	2.	3.	4.	5.
Wakefield, U. - -	33,676	Yes	Yes	Continuous.
Altofts, U. - -	3,700	Yes	Yes	Intermittent.
Featherstone, U. - -	3,500	—	—	—
Normanton, U. - -	10,800	—	—	—
Sandal Magna, U. -	4,000	Yes	Yes	Intermittent.
Whitwood, U. - -	5,000	Yes	Yes	Continuous.
Wakefield, R. - -	34,700	Yes	Yes	Intermittent.
	95,376			

From the above table it appears that water is supplied from the Wakefield Corporation Waterworks to the city of Wakefield, and to portions of six sanitary districts (five urban, one rural) situate outside the limits of the city. The total population so supplied is estimated at 95,376 persons. In all the districts, with the exception of the Featherstone and Normanton Urban Sanitary Districts (to which the supply has only been laid on for a few months), lead poisoning is reported to have been more or less prevalent amongst the consumers of this water.

In the urban districts of Altofts and Sandal Magna, and in the rural district of Wakefield, the poisoning is stated to have been intermittent in character; whilst in the urban districts of Wakefield and Whitwood it is reported to have been continuous. With respect to the Wakefield water supply, it is interesting to observe that the Medical Officer of Health for the urban sanitary district of Rishworth, in which the gathering grounds of the Wakefield Waterworks are situate, reports that the private supply of the Rishworth Grammar School, obtained from moorland gathering ground in that district, also possesses plumbo-solvent properties.

(q.) *Yeadon Waterworks Company.*

The water supply of the Yeadon Water Company is derived partly from the surface drainage of elevated meadow and pasture land, and partly from wells sunk in the sandstone near to Yeadon. The water is stated to be imperfectly filtered though sand and gravel before delivery to consumers. It is estimated that this company furnishes water to 7,695 persons living in the urban sanitary district of Yeadon, and to 2,000 persons living in the adjoining urban sanitary district of Rawdon. No cases of plumbism attributable to this water supply have been observed amongst the consumers of the water living in Yeadon. One case is reported to have occurred 12 or 13 years ago in Rawdon, in a house where the service pipe was of unusual length.

(r.) *Waterworks outside the West Riding furnishing public supplies to Districts within the Riding.*

In Table XII. is given a summary of the information obtained with respect to those sanitary districts situate in the West Riding which obtain the whole or part of their water supply from works outside the Riding.

Table XII.

Waterworks situate outside the West Riding which furnish Public Water Supply to 7 Sanitary Districts within the Riding.

Name by which Waterworks designated.	Districts or portions of Districts supplied.	Estimated Population receiving Supply.	Source.	Filtered or Treated.	Remarks with respect to Lead Poisoning (if any).
1.	2.	3.	4.	5.	6.
Ashton-under-Lyne, Stalybridge, and Dukinfield (District) Waterworks Joint Committee.	Upper Mill, U. Saddleworth, R. (part of), Greenfield, Saddleworth, Delph.	1,000 5,400	Moorland	No.	—
Chesterfield Rural Sanitary Authority's Waterworks.	Rotherham, R. (Beighton).	2,000	Moorland	Treated with limestone.	—
Clitheroe Corporation Waterworks.	Clitheroe, R. (part of), West Bradford.	311	Moorland	No.	—
Oldham Corporation Waterworks.	Quickmere, U.	2,670	Gathering grounds in upper valleys of Irwell and Medlock.	No.	—
York Water works Company.	Great Ouseburn, R. (part of), Acomb.	2,000	River Ouse.	Filtered.	—
	York, R. (part of), Dringhouses, and Middlethorpe.	680			
		14,061			

From this table it will be seen that the waterworks outside the Riding, from which public supply is obtained, are five in number—three being situate in Lancashire, one in Derbyshire, and one in the North Riding of Yorkshire. These works furnish public supplies to portions of seven sanitary districts in the West Riding (two urban and five rural). The population supplied from these works is estimated at 14,061.

In none of the districts receiving these outside supplies have any cases of plumbism, attributable to water supply, been observed.

(s.) *Urban Sanitary Districts having Public Water Supply from Local Sources.*

In Table XIII. is given a summary of the information obtained with respect to the public water supply of urban sanitary districts where such supply is obtained from local sources.

Table XIII.

Summary of information with respect to the Public Water Supply of 31 Urban Sanitary Districts in which the Supply is wholly or partly obtained from Local Sources.

(Where the name of the district is printed in *Italics*, no portion of the public water supply is obtained from sources outside the district.)

District.	Name by which Water Supply designated.	Estimated Population receiving Supply	Source.	Filtered or Treated.	Remarks with respect to Lead [illegible] Cases.
1.	2.	3.	4.	5.	6.
Austonley, U.	The Public Tank	500	Spring	No.	—
Baildon, U.	Baildon Waterworks	6,000	Springs on Baildon Moor.	No.	—
Bingley, I. D. (part of).	Bingley Reservoir	7,000	Surface springs	No.	—
Bingley Township, U. (part of).	(*a.*) Cullingworth Water Supply.	1,600	Springs	No.	—
" "	(*b.*) Cottingley Water Company.	820	Springs	No.	—
Burley-in-Wharfedale, U.	Burley Local Board Waterworks.	2,600	Springs on Burley Moor.	No.	—
Calverley, U. (part of).	Thornhill's Reservoir	1,500	Springs	No.	—
Denholme, U. (part of).	Foster's Water Supply	1,275	Springs	No.	—
Farnley Tyas, U.	Farnley Tyas Water Supply.	400	Farnley Moor	No.	—
Golcar, U. (part of)	Taylor's Waterworks	1,550	Springs	No.	—
Goole, U.	Goole Gas and Water Company.	13,000	Deep well in new red sandstone.	No.	—
Guiseley, U.	Guiseley Waterworks	2,700	Well in red sandstone.	No.	—
Harrogate, U.	Harrogate Waterworks Company.	14,000	Haverah Park	Filtered	One case where long service pipe in use during last 14 years.
Haworth, U.	Haworth Local Board Waterworks.	3,640	Springs and moorland.	No.	—
Holmfirth, U.	(*a.*) Holmfirth Reservoir.	5,556	Snape Farm	No.	—
" "	(*b.*) Newfold Tank	3,500	Newfold	No.	—
Horsforth, U.	Horsforth Waterworks Company.	6,750	Horsforth and Yeadon Moor.	Filtered.	—
Ilkley, U.	Ilkley Local Board Waterworks.	6,000	Ilkley Moors	No.	—
Knaresborough and Tentergate, U.	Knaresborough Waterworks.	5,000	River Nidd	Filtered.	—
Luddendenfoot, U.	Whitworth's Reservoir.	2,000	Blackwood Hall.	No.	—
Meltham, U.	Meltham Local Board Waterworks.	3,750	Springs	No.	—
Mexborough, U.	Mexborough Water Company.	3,600	Well in coal measures.	No	Practically none.

TABLE XIII.—*continued.*

District.	Name by which Water Supply designated.	Estimated Population receiving Supply.	Source.	Filtered or Treated.	Remarks with respect to Lead Poisoning (if any).
1.	2.	3.	4.	5.	6.
Otley, U. - -	Otley Waterworks -	8,000	Streams -	No.	—
Penistone, U. -	Penistone Waterworks	2,400	Moorland and deep springs.	No.	—
Pontefract, U. -	Pontefract Corporation Waterworks.	6,888	Deep wells in coal measures.	No.	—
Rawdon, U. (part of).	(*a.*) Billing and Tough's Reservoir.	600	Drifts into Billing Hill.	No.	—
„ „	(*b.*) Peacock Inn Supply.	75	Drift - - -	No.	—
Selby, U. - -	Selby Waterworks -	5,910	Bore-holes in the new red sandstone.	No.	—
Shipley, U. -	Eldwick Waterworks	18,000	Rombald's Moor.	No	One case only where long service pipe in use.
Skipton, U. -	Skipton Waterworks -	11,700	Rombald's Moor and pasture land.	Partly filtered.	—
Stocksbridge, U. -	(*a.*) Low Level Service.	4,320	Springs -	No.	—
„ „ -	(*b.*) High Level Service.	540	Springs -	No.	—
Swinton, U. -	Swinton Local Board Waterworks.	10,000	Well in carboniferous sandstone.	Treated with milk of lime and filtered.	—
Todmorden, U. -	(*a.*) Todmorden Waterworks Company.	1,150	Moorland -	No.	—
„ „ -	(*b.*) Greenwood's Trustees.	800	Springs -	Yes.	—
„ „ -	(*c.*) Various - -	960	Springs -	No	In a few isolated cases where long service pipes have been in use.
Wath-upon-Dearne, U.	West Melton Water Company.	6,000	Pasture and arable land.	Filtered.	—
		170,084			

The above table refers to a population of 170,084 persons, resident in the 31 urban sanitary districts, who receive their supply from local sources. In the case of three districts only, those of Harrogate, Shipley, and Todmorden have isolated cases of plumbism, due to water supply, been observed; and all the cases are stated to have occurred in houses furnished with lead service pipes of unusual length.

(t.) *Rural Sanitary Districts having Public Water Supply from Local Sources.*

In Table XIV. a summary is given of the information obtained with respect to the public water supply of rural sanitary districts when such supply is obtained from local sources.

Table XIV.

Summary of Information with respect to the Public Water Supply of 13 Rural Sanitary Districts in which the Supply is obtained from Local Sources.

(Where the name of the district is printed in *Italics*, no portion of the public water supply is obtained from sources outside the district.)

Names of Rural Sanitary Districts and Townships supplied.	Name by which Water Supply designated.	Estimated population receiving [illegible]	[illegible]	Filtered or Treated.	Lead Poisoning
1.	2	4	5	7	8
Barnsley, R. (part of): (Carlton)	Earl of Wharncliffe's Waterworks.	1,000	Partly gathering ground and partly from coal pit.	No.	—
Clitheroe, R. (part of): (*a.*) Waddington	(*a.*) Waddington Waterworks.	447	Moorland	No.	—
(*b.*) Bashall Eaves	(*b.*) Taylor's Reservoir	263	Spring	No.	—
Halifax, R. (part of): Norland	Norland Waterworks	1,500	Moorland	No.	—
Hunslet, R. (part of): Temple Newsam	Temple Newsam Waterworks.	2,200	Pasture land and springs.	No.	—
Keighley, R.: (*a.*) Steeton and Eastburn.	Steeton Waterworks	1,215	Springs	No.	—
(*b.*) Sutton	Sutton Waterworks	1,237	Springs	No.	—
(*c.*) East Morton	East Morton Waterworks Company.	1,030	Springs	No.	—
(*d.*) Morton Banks	Morton Banks Water Company	397	Springs	No.	—
Pateley Bridge, R.: Pateley Bridge	Pateley Bridge Waterworks.	500	Pateley Moor	No.	—
Ripon, R. (part of): (*a.*) North Lees	Ripon Rural Sanitary Authority's Water Services.	[illegible]	Local springs within township supplied.	No.	—
(*b.*) Hutton Conyers		[illegible]			
(*c.*) Rainton		400			
(*d.*) Bishop Monkton.		500			
(*e.*) Markington		[illegible]			
(*f.*) Melmerby		[illegible]			
Sedbergh, R.: (*a.*) Sedbergh	Sedbergh Waterworks	1,000	Gathering ground and springs.	Filtered.	—
(*b.*) Dent	Dent Water Supply	350	Spring	No.	—
Settle, R.: (*a.*) Settle and Giggleswick.	Settle and Giggleswick Waterworks.	2,515	Springs in Scaleber.	No.	—
(*b.*) Ingleton	Ingleton Waterworks	1,000	Springs in Ingleborough.	Filtered.	—
(*c.*) High and Low Bentham.	Bentham Waterworks	1,377	Moorland stream	Filtered.	—
(*d.*) Long Preston	Long Preston Water Company.	607	Springs	No.	—
(*e.*) Burton-in-Lonsdale.	Burton-in-Lonsdale Water Company.	394	Springs	No.	—
(*f.*) Clapham	Clapham Water Supply.	295	Ingleborough Lake.	Filtered.	—

TABLE XIV.—*continued.*

Names of Rural Sanitary Districts and Townships supplied.	Name by which Water Supply designated.	Estimated Population receiving Supply.	Source.	Filtered or Treated.	Remarks with respect to Lead Poisoning (if any).
1.	2.	3.	4.	5.	6.
Skipton, R. (part of):					
(*a.*) Gargrave	Gargrave Rural Sanitary Authority Waterworks.	903	Thorlber Fell springs.	No.	—
(*b.*) Crosshills and Glusburn.	Crosshills and Glusburn Water Company.	1,200	Ling Haw springs.	No.	—
(*c.*) Farnhill	Farnhill Water Company.	500	Moor Edge springs.	No.	—
(*d.*) Bradley	Bradley Water Company.	400	Lowersire Bank springs.	No.	—
(*e.*) Embsay	Embsay Water Company.	700	Embsay Fell	Filtered.	—
(*f.*) Carleton	Carleton Water Company.	650	Springs	No.	—
(*g.*) Cowling	Cowling Water Company.	1,500	Springs	No.	—
(*h.*) Kelbrook	Kelbrook Water Company.	540	Spring	No.	—
(*i.*) Salterforth	Salterforth Water Company.	220	Spring	No.	—
(*k.*) Grassington	Grassington Water Company.	450	Spring	No.	—
(*l.*) Cononley	Cononley Water Company.	560	Gib Side	No.	—
(*m.*) Hebden	Hebden Rural Sanitary Authority Waterworks.	240	Scar Side	No.	—
Wharfedale, R. (part of):					
(*a.*) Menston	Menston Waterworks Company.	500	Moorland	No.	—
(*b.*) Bramhope	Bramhope Waterworks Company.	258	Deep wells	No.	—
(*c.*) Esholt	Esholt Waterworks	180	Deep springs	No.	—
(*d.*) Hawksworth	Hawksworth Waterworks.	100	Deep springs	No.	—
(*e.*) Poole	Poole Waterworks	574	Springs and moorlands.	No.	—
(*f.*) Timble	Timble Waterworks	171	Spring	No.	—
Worksop, R.: (Yorkshire portion):					
(*a.*) South Anston	South Anston Rural Sanitary Authority Water Supply.	700	Gathering ground.	No.	—
(*b.*) Kiveton	Kiveton Water Supply	1,300	Springs	No.	—
(*c.*) Harthill	Harthill Water Supply	600	Well bored in gritstone.	No.	—
Wortley, R. (part of):					
(*a.*) Wortley	Wortley Waterworks	4,000	Wharncliffe Estate.	No.	—
(*b.*) Oughtibridge	Oughtibridge Waterworks.	1,200	Springs	No.	—
		36,520			

The above table refers to a population estimated at 36,520 persons, resident in the 13 rural sanitary districts who receive a public water supply from local sources. These local supplies are 47 in number, and furnish supplies to groups of persons varying from 40 to 4,000 in number. The supplies are drawn from very varied sources, yet amongst the consumers of these waters no cases of plumbism have hitherto been observed which could be attributed to the water.

Summary of facts enumerated.

(*a.*) As regards water supply:

(1.) Of the total population of the West Riding of Yorkshire, nearly 18 per cent. do not, at the present time, receive water supply from public sources.

(2.) In the county boroughs practically the whole population receive water supply from public sources.

(3.) In the urban sanitary districts, other than county boroughs, a little over 60 per cent. of the population receive water supply from public sources, whilst nearly 40 per cent. still depend on private sources for water.

(4.) In the rural sanitary districts, only some 40 per cent. of the population receive water supply from public sources, whilst 60 per cent. still depend on private sources for water.

(*b.*) As regards lead poisoning in relation with water supply:

(1.) The waters supplied from the works of six of the trading corporations, namely, Bradford (high level supply), Huddersfield, Sheffield (high level supply), Batley, Keighley, and Wakefield, are each reported to have exhibited strong plumbo-solvent property; whilst water supplied by the Dewsbury and Heckmondwike Water Board, and water from some of the Todmorden Waterworks, apparently possesses plumbo-solvent property in a minor degree.

(2.) The population of the several districts supplied with water from the above-named works, and subject to lead poisoning apparently attributable to water supply, amounts in the aggregate to upwards of 700,000 persons.

(3.) In certain districts where water supply is also obtained from the works first enumerated, and which have an aggregate population of upwards of 60,000 persons, no cases of lead poisoning have been observed.

(4.) All the waters reported to have plumbo-solvent properties in the West Riding of Yorkshire are derived from moorland gathering grounds.

(5.) In the majority of the districts subject to plumbism the lead poisoning is stated to be intermittent in character.

May, 1891.

ADDENDUM C.

Records of Water Supplies in the Sanitary Districts of the Counties of Lancaster, Cumberland, and Westmorland, collected as introductory to an investigation by the Medical Department of the Local Conditions affecting the Solubility of Lead by Water; by Mr. T. W. Thompson.

In accordance with instructions having reference to the investigation, entrusted to the Department, into the occurrence of lead poisoning in association with public water supplies, and into the conditions under which such supplies acquire ability to dissolve the lead of pipes and cisterns, I have addressed to the Medical Officers of Health of the several urban and rural sanitary districts in the counties of Lancaster, Cumberland, and Westmorland —counties in which the water supplies were known to be largely derived from upland gathering grounds—a set of questions, designed to obtain certain preliminary data as to water supply, along with facts as to the occurrence or not of lead poisoning in connexion therewith.

In this memorandum I now submit certain analyses of the replies received from the different health officers, and certain tabular returns of the data upon which such analyses are based. The data in question consist in the main, district by district, of the information supplied by the Medical Officers of Health, arranged in a form to facilitate reference; but they are supplemented as regards particular districts by matter (printed in italics) obtained from Medical Officers of Health of other districts also supplied with the water that comes in question. On these returns I have also noted the area of each district as given in the 1881 Census Report; and as regards each urban sanitary district the population for 1881 and 1891, as given in the recently published Preliminary Census Report. The 1881 population entered in each instance on the returns for the rural sanitary districts is taken from the 1881 Census Report; but the estimated population in 1890 for each of these districts was supplied by the Medical Officer of Health for each district.

Throughout this memorandum, except in these introductory remarks, the three counties above named are dealt with separately, being taken in the order of their relative importance from the point of view of population. Thus, first for Lancashire, next for Cumberland, and lastly for Westmorland, the data got together are dealt with as follows:—

1. Tables I., II., and III., in which the *sanitary areas* of the county are the governing units; such areas being grouped according as they are county boroughs (Table I.),* urban sanitary districts (Table II.), or rural sanitary districts (Table III.). These tables show (col. 5) the estimated population in each different sanitary area receiving water by public service, and similarly (cols. 6 and 7), the estimated population dependent on private sources of supply.
2. Tables IV.,† V., VI., and VII., in which *water supplies* in the county are the governing units; the water supplies being grouped according as they belong to county boroughs, to water companies and trusts, to urban sanitary districts, or to rural sanitary districts. These tables show (col. 2) the several districts or localities served by each water service; the estimated population (col. 3) in each instance receiving such supply; the source or sources of the water (col. 4); certain facts as to "treatment" of the water and its delivery to customers (cols. 5, 6, and 7); and finally (col. 8), the presence or absence of lead poisoning among such consumers as recorded by the Medical Officers of Health of the districts supplied therewith.
3. ‡A return for the county of the replies received from the Medical Officers of Health to the different districts; these replies being grouped

* There being no county boroughs in Cumberland and Westmorland, Table I. will not be found in the analyses for those counties.

† There being no county boroughs in Cumberland or Westmorland, Table IV. will not be found in the analyses for those counties.

‡ In view of the summary of these data which is given in Tables IV., V., VI., and VII. it has not been deemed requisite to reproduce here the full district returns appended to Mr. Thompson's memorandum.

separately according as they relate to county boroughs, urban sanitary districts, or rural sanitary districts—the areas in each group being dealt with in alphabetical order.

Before proceeding to deal with each county separately, it needs to be pointed out that these records, taken collectively, have reference to the water supplies of an extensive district with an area of upwards of 2,676,900 acres, and a population of some 4,356,000 persons. Apart, therefore, from the immediate object with which they have been obtained, they promise to prove useful for purposes of general reference.

Also it will be convenient here to summarise the information obtained.

(a.) *As regards water supply:*

(1.) Of the total population of each of the three counties under consideration, nearly 7 per cent. in the case of Lancashire, 34 per cent. in the case of Cumberland, and nearly 59 per cent. in the case of Westmorland, are at present unprovided with any public water supply.

(2.) Of the county boroughs in Lancashire, practically all the inhabitants obtain their water from some public source.

(3.) Of the urban sanitary districts, other than county boroughs, approximately 6 per cent. of the population of those in Lancashire, 3 per cent. of those in Cumberland, and 3 per cent. of those in Westmorland are still dependent upon private sources of supply.

(4.) Of the rural sanitary districts, some 54 per cent. of the population of those in Lancashire, 75 per cent. of those in Cumberland, and 93 per cent. of those in Westmorland are also still dependent upon private sources of supply.

(b.) *As regards lead poisoning in relation with water supply:*

(1.) Conspicuous lead poisoning has only been heard of in connexion with two public water supplies in Lancashire, viz., the Rochdale Corporation supply and the supply of the Rossendale Water Company; though in a minor degree lead poisoning has been mainly associated with the Darwen Corporation supply, Skelsmersdale Local Board supply, and apparently also to a slight extent in the past with the supplies of The Fylde and Tintwistle Companies. Some other Lancashire waters would also appear to have ability to act slightly upon lead, but no notable amount of plumbism has at present been observed to follow their use.

(2.) With the exception of a past history of lead poisoning, possibly in association with the Whitehaven Local Board's water supply, no lead poisoning attributable to public water supply has been heard of either in Cumberland or Westmorland, though in both these counties the plumbo-solvent action of the waters, if they possess such, is largely obscured by the scarcity of lead service pipes and cisterns.

(1.) Lancashire.

Replies to the questions above referred to, and reproduced in Appendix A., have been received from the Medical Officers of Health to 152 sanitary districts situated either wholly or partly in the county of Lancaster, and having an aggregate area of 1,203,708 acres, and a population of some 4,020,328 persons.

Of these 4,020,328 persons it appears that, approximately, 93 per cent. obtain water from some public service, while rather less than 7 per cent. are dependent upon private sources of supply.

Three of the above-mentioned 152 districts, viz., Crumpsall Urban, Newton Heath Urban, and Openshaw Urban, have recently been added to the city of Manchester. The information furnished by the late Medical Officers of Health to these districts is entered on the return, but the population of the districts is included in that of Manchester.

The remaining 149 districts comprise (*a*) 15 county boroughs, having collectively in 1891 a Census population of 2,208,737 persons; (*b*) 113 urban sanitary districts, having in 1891 a Census population of 1,490,159 persons; and (*c*) 21 rural sanitary districts, having in 1890 an estimated population of 321,432 persons.

A.—Water Supplies: Public and Other.

In Table I.A. will be found certain general data with respect to the water supply of the 15 county boroughs in the county of Lancaster, from which it will be seen that out of an aggregate population of 2,208,737 persons, it is estimated that 2,205,137, or practically 99·8 per cent., obtain their water supply from public services, while only about 3,600, or rather less than 0·2 per cent. of the whole, are dependent upon private sources.

Table I.A. [Lancashire.]

Summary of Returns with respect to the Water Supply of the 15 County Boroughs wholly or partly situate in the County of Lancaster.

Name of County Borough.	Area in Acres. (1881 Census Report.)	Population, 1881. (Preliminary Census Report, 1891.)	Population, 1891. (Preliminary Census Report, 1891.)	In County Boroughs having Public Water Supply. Estimated Population		Population of County Boroughs wholly dependent on Private Sources of Supply.
				Served from Public Source.	Dependent on Private Sources.	
1.	2.	3.	4.	5.	6.	7.
Barrow-in-Furness	10,456	47,259	51,712	51,712	—	—
Blackburn	6,974	104,014	120,064	119,564	500	—
Bolton	2,404	105,414	115,002	115,002	—	—
Bootle	1,207	27,374	49,217	49,217	—	—
Burnley	1,731	63,339	87,058	87,058	—	—
Bury	3,390	54,717	57,206	57,206	—	—
Liverpool	5,210	552,508	517,951	517,951	—	—
Manchester	4,293	462,303	505,343	505,343	—	—
Oldham	4,730	111,343	131,463	131,463	—	—
Preston	3,721	96,537	107,573	107,573	—	—
Rochdale	4,172	68,866	71,458	68,458	3,000	—
St. Helens	6,586	57,403	71,288	71,188	100	—
Salford	5,170	176,235	198,136	198,136	—	—
Stockport	2,200	59,553	70,253	70,253	—	—
Wigan	2,188	48,194	55,013	55,013	—	—
Totals	64,432	2,035,059	2,208,737	2,205,137	3,600	—

In Table II.A. will be found similar data with respect to the water supply of 113 urban sanitary districts in the county of Lancaster, from which it will be seen that out of an aggregate population of 1,490,159 persons, it is estimated that 1,402,783, or 94 per cent., obtain their water supply from public services, while 87,376, or nearly 6 per cent., are dependent upon private sources. It will further be seen that as regards the four urban sanitary districts of Croston, Rainford, Standish-with-Langtree, and Upholland, which together have a population of 15,365 persons, no public provision has at present been made in the matter of water supply.

App. A. No. 13.

On the Causes of Local Mortality, &c. Mr. Power.

Table II.a. [Lancashire.]

Summary of Returns with respect to the Water Supply of 114 Urban Sanitary Districts (other than County Boroughs) situate either wholly or in part within the County of Lancaster.

Name of Urban Sanitary District.	Area in Acres. (1881 Census Report.)	Population, 1881. (Preliminary Census Report, 1891.)	Population. 1891 (Preliminary Census Report, 1891.)	In Urban Districts having Public Water Supply. Estimated Population*		Population of Urban Districts wholly dependent on Private Sources of Supply
				Served from Public Sources	Dependent on Private Sources	
1.	2.	3.	4.	5.	6.	7.
Abram	1,982	2,688	4,309	4,259	*50*	—
Accrington	3,425	31,435	38,603	38,603	—	—
Adlington	1,064	3,258	4,190	4,190	—	—
Allerton	1,586	830	914	914	—	—
Ashton-in-Makerfield	6,250	9,824	13,379	*10,846*	*2,533*	—
Ashton-under-Lyne	1,891	37,040	40,494	40,494	—	—
Aspull	1,905	8,113	8,952	8,952	—	—
Astley Bridge	1,768	5,613	6,239	*6,139*	*100*	—
Atherton	2,426	12,602	15,833	15,833	—	—
Audenshaw	1,165	5,936	6,547	6,547	—	—
Bacup	6,400	25,034	23,498	*4,240*	*19,258*	—
Barton, Eccles, Winton, and Monton	2,361	21,786	29,606	29,606	—	—
Billinge	4,591	3,882	3,996	3,866	130	—
Birkdale	2,215	8,705	12,387	12,387	—	—
Blackpool	3,496	14,229	23,846	*23,596*	*250*	—
Blackrod	2,388	4,234	4,021	4,021	—	—
Brierfield	1,017	4,088	5,888	*5,808*	*80*	—
Castleton-by-Rochdale	2,344	4,017	4,857	4,340	517	—
Chadderton	3,082	16,899	22,087	*21,887*	*200*	—
Childwall	1,729	187	199	199	—	—
Chorley	3,614	19,478	23,082	23,082	—	—
Church	528	4,850	5,870	5,870	—	—
Clayton-le-Moors	1,059	6,695	7,155	7,155	—	—
Clitheroe	2,375	10,176	10,815	10,600	215	—
Colne and Marsden	5,329	11,971	16,774	16,774	—	—
Crompton	2,864	9,797	12,901	12,851	50	—
Croston	2,361	1,791	2,034	—	—	2,034
Crumpsall †	733	—	—	—	—	—
Dalton-in-Furness	7,223	13,339	13,300	13,300	—	—
Darwen	5,918	29,744	34,192	32,692	1,500	—
Denton and Haughton	1,706	12,711	18,993	18,793	200	—
Droylsden	1,144	8,687	9,482	9,482	—	—
Failsworth	1,073	7,912	10,425	10,425	—	—
Farnworth	1,502	20,708	23,758	23,758	—	—
Fleetwood	1,800	6,733	9,274	9,274	—	—
Fullwood	2,117	3,725	4,112	*4,006*	*106*	—
Garston	1,625	10,271	13,444	13,444	—	—
Gorton	1,484	12,031	15,215	*15,162*	*53*	—

* The figures in columns 5 and 6 in *italics* are estimates of my own, based upon the replies of the Medical Officers of Health.—T. W. T.

† Recently added to Manchester.

TABLE II.A. [LANCASHIRE]—*continued*.

Name of Urban Sanitary District.	Area in Acres. (1881 Census Report.)	Population, 1881. (Preliminary Census Report, 1891.)	Population, 1891. (Preliminary Census Report, 1891.)	In Urban Districts having Public Water Supply. Estimated Population*		Population of Urban Districts wholly dependent on Private Sources of Supply.
				Served from Public Source.	Dependent on Private Sources.	
1.	2.	3.	4.	5.	6.	7.
Grange	1,160	1,150	1,733	1,633	100	—
Great Crosby	1,768	5,033	6,400	6,400	—	—
Great Harwood	2,863	6,287	9,073	9,073	—	—
Haslingden	3,627	16,298	18,225	17,000	1,225	—
Haydock	2,409	5,863	6,535	*6,509*	*26*	—
Heaton Norris	1,564	5,797	7,164	7,164	—	—
Heywood	3,496	22,979	23,286	23,286	—	—
Hindley	2,611	14,715	18,973	18,973	—	—
Horwich	3,254	3,761	12,850	12,700	150	—
Hurst	540	6,384	6,772	6,772	—	—
Huyton-with-Roby	3,054	4,060	4,625	4,625	—	—
Ince-in-Makerfield	2,320	16,007	19,255	19,255	—	—
Kearsley	997	7,253	7,993	*7,900*	*93*	—
Kirkham	857	3,840	3,995	*3,889*	*106*	—
Lancaster	1,494	24,239	31,038	31,038	—	—
Lathom	8,694	4,161	4,371	205	4,166	—
Lees	202	3,511	3,877	3,872	5	—
Leigh	6,192	21,734	28,702	28,702	—	—
Levenshulme	606	3,557	5,506	5,506	—	—
Leyland	3,726	4,961	5,972	4,500	1,472	—
Litherland	850	2,426	4,441	4,441	—	—
Littleborough	7,737	10,406	10,878	9,000	1,878	—
Little Crosby	1,811	553	641	212	*429*	—
Little Hulton	1,707	5,714	6,697	6,697	—	—
Little Lever	807	4,413	5,168	5,168	—	—
Little Woolton	1,388	1,159	1,131	1,131	—	—
Longridge	3,123	3,705	4,101	3,500	601	—
Lytham	2,238	4,122	4,656	4,636	20	—
Middleton	4,585	18,953	21,310	*21,110*	*200*	—
Milnrow	5,264	7,013	8,046	5,364	2,682	—
Morecambe	1,725	3,931	6,476	6,476	—	—
Mossley	1,500	13,850	14,162	14,162	—	—
Moss-side	420	18,131	23,833	23,833	—	—
Much Woolton	795	4,541	4,545	4,545	—	—
Nelson	827	10,381	22,700	22,700	—	—
[Newton Heath†	1,350	—	—	—	—	—]
Newton-in-Makerfield	3,103	10,580	12,861	12,000	861	—
Norden	6,033	4,043	3,955	2,400	1,555	—]
[Openshaw†	579	—	—	—	—	—
Ormskirk	573	6,651	6,298	6,298	—	—
Orrell	1,618	4,299	4,914	4,914	—	—
Oswaldtwistle	4,883	12,206	13,296	13,296	—	—
Padiham and Hapton	950	8,974	11,311	11,311	—	—
Pemberton	2,894	13,762	18,400	18,000	400	—
Prescot	268	6,419	6,745	6,745	—	—
Prestwich	1,917	8,627	7,869	7,869	—	—

* *See* Note * on p. 372. † Recently added to Manchester.

TABLE II.A. [LANCASHIRE]—*continued.*

Name of Urban Sanitary District.	Area in Acres (1881 Census Report.)	Population, 1881 (Preliminary Census Report, 1891.)	Population, 1891 (Preliminary Census Report, 1891.)	In Urban Districts having Public Water Supply. Estimated Population.*		Population in Urban Districts wholly dependent on Private Sources of Supply
				Served from Public Sources.	Dependent on Private Sources.	
1.	2.	3.	4.	5.	6.	7.
Radcliffe	2,453	16,267	20,020	20,020	—	—
Ramford	5,872	3,745	3,472	—	—	3,472
Ramsbottom	290	16,142	16,726	14,000	2,726	—
Rawtenstall	1,667	28,913	29,507	19,672	9,835	—
Reddish	1,541	5,557	6,854	6,854	—	—
Rishton	2,983	4,055	6,010	6,010	—	—
Royton	2,142	11,433	13,595	13,595	—	—
St. Anne's-on-Sea	3,292	1,179	2,588	2,578	10	—
Skelmersdale	1,941	5,707	6,627	6,627	—	—
Southport	3,665	32,206	43,026	43,026	—	—
Stalybridge	806	25,977	26,783	26,783	—	—
Standish with Langtree	3,265	4,261	5,416	—	—	5,416
Stretford	3,255	19,018	21,751	21,751	—	—
Swinton and Pendlebury	2,166	18,107	20,197	20,197	—	—
Toxteth Park	1,500	10,568	21,046	21,046	—	—
Trawden	6,808	2,164	2,354	1,800	554	—
Turton	4,614	5,553	6,854	4,766	1,588	—
Tyldesley-with-Shakerley	2,490	9,954	12,891	12,801	90	—
Ulverstone	3,120	10,008	9,948	9,848	100	—
Upholland	4,685	4,435	4,443	—	—	4,443
Walton-le-Dale	4,683	9,286	10,556	9,070	1,486	—
Walton-on-the-Hill	1,907	18,546	40,304	40,304	—	—
Warrington	1,442	42,552	52,742	52,742	—	—
Waterloo-with-Seaforth	740	9,118	17,328	17,328	—	—
Wavertree	1,858	11,097	15,764	15,764	—	—
West Derby	5,561	33,614	38,291	30,000	8,291	—
Westhoughton	4,841	9,197	11,077	10,100	977	—
Whitefield	2,948	9,516	10,781	10,781	—	—
Whitworth	8,000	11,892	9,766	4,883	4,883	—
Widnes	3,339	24,935	30,011	29,911	100	—
Withington	5,728	17,109	25,729	25,679	100	—
Worsley and Wardle	5,086	4,640	5,952	3,902	50	—
Totals	308,557	1,214,059	1,490,159	1,402,783	72,911	15,365

* *See* Note * on p. 372.

In Table III.A. will be found similar data with respect to the 21 rural sanitary districts in the county of Lancaster, from which it will be seen that, out of an aggregate estimated population of 321,432 persons, it is computed that 148,619, or only about 46 per cent. of the whole, obtained their water supply from public sources, while as many as 172,813 persons, or nearly 54 per cent., are dependent upon private sources of supply.

TABLE III.A. [LANCASHIRE.]

SUMMARY of RETURNS with respect to the WATER SUPPLY of 21 RURAL SANITARY DISTRICTS situate wholly or partly within the County of LANCASTER.

Name of Rural Sanitary District.	Area in Acres. (1881 Census Report.)	Population, 1881. (1881 Census Report.)	Population, 1890. (Estimated.)	In Rural Districts having Public Water Supply. Estimated Population		Population of Rural Districts wholly dependent on Private Sources of Supply.
				Served from Public Source.	Dependent on Private Sources.	
1.	2.	3.	4.	5.	6.	7.
Ashton-under-Lyne -	21,360	14,560	12,433	*11,400*	*1,033*	—
Barton-upon-Irwell -	17,755	19,195	26,550	26,000	550	—
Blackburn - -	20,647	8,103	8,102	2,320	5,782	—
Bolton - -	25,032	24,679	27,636	*27,136*	*500*	—
Burnley - -	46,910	21,672	27,000	7,100	19,900	—
Bury - -	20,882	24,719	15,224	12,000	3,224	—
Chorley - -	43,691	18,242	19,000	290	18,710	—
Clitheroe - -	30,889	7,501	7,500	2,000	5,500	—
The Fylde - -	47,349	10,807	11,850	6,110	5,740	—
Garstang - -	61,115	12,375	13,000	3,250	9,750	—
Lancaster - -	59,279	16,244	14,786	5,200	9,586	—
Leigh - -	13,248	12,028	5,250	5,000	250	—
Lunesdale - -	75,734	7,132	7,132	1,435	5,697	—
Ormskirk - -	73,574	25,782	30,888	10,370	20,518	—
Prescot - -	34,290	15,698	17,083	6,956	10,127	—
Preston - -	53,895	15,907	14,387	1,956	12,431	—
Prestwich - -	4,972	17,606	16,365	*15,500*	*865*	—
Ulverstone - -	129,621	19,184	20,000	300	19,700	—
Warrington - -	24,214	12,323	16,560	1,900	14,660	—
West Derby -	14,561	4,550	5,000	1,210	3,790	—
Wigan - -	11,701	5,554	5,686	1,186	4,500	—
Totals - -	830,719	313,861	321,432	148,619	172,813	—

(B.) PUBLIC WATER SUPPLIES AND LEAD POISONING.

In Tables IV.A. to VII.A. will be found an analysis of the circumstances, as regards source, delivery, and distribution, of the public water supplies in the county of Lancaster; together with information as to the recognised presence or apparent absence of lead poisoning in connexion with such supplies.

These tables also illustrate the extent to which trade in water is carried on in Lancashire. In this connexion it appears that out of the total 143 sanitary districts to which, exclusive of the six county boroughs named below, the Lancashire returns refer, no less than 86 (three county boroughs, 74 urban sanitary districts, and nine rural sanitary districts) obtain either the whole or a part of their water supply from one or other of the following six county borough corporations or three water companies or water trusts, viz., the Bolton, Bury, Liverpool, Manchester, Oldham, and Rochdale Corporations, and the Accrington Gas and Water Company, the Ashton-under-Lyne, Stalybridge, and Dukinfield (District) Waterworks Joint Committee, and the Fylde Water Company. The population thus supplied by these nine bodies, exclusive of the population of the districts proper to the six corporations enumerated, amounts to some 1,280,000 persons. The total population supplied by them (*i.e.*, including the population of the six county boroughs) amounts to over 2,677,000 persons, or about 66 per cent. of the population of the whole 149 districts included in the Lancashire return.

Water trading in Lancashire is also carried on on a smaller scale by other county boroughs, urban sanitary authorities, and water companies.

As regards lead poisoning, it would seem, from the information given in column 8 of the tables now under consideration, that very few of the Lancashire water supplies at present exhibit, or have in the past exhibited, any very vigorous action on lead pipes.

Considering first the twelve water supplies possessed by county boroughs (Table IV.A.), the evidence on this point is, except in the case of a single water supply (that of the Rochdale Corporation), to the effect that almost no lead poisoning, clearly referable to public water supply, has been observed. Moreover, as regards several of these supplies, and this is notably the case with respect to the supplies of Liverpool and Manchester, the import of this evidence is enhanced by the fact that it comes from a number of independent sources. It would therefore seem that so far, at least, no conspicuous amount of lead poisoning has occurred as a consequence of the use of eleven of the twelve waters in question. Nevertheless it is worthy of note that the majority of these waters appear to be obtained, either exclusively or largely, from moorland gathering grounds.

But although as regards these eleven waters there is absence of evidence as to their acting vigorously upon lead pipes, the conclusion that they have no action whatever upon such pipes would not seem warranted, and as regards certain of them there is some indication of the opposite being the case. This will be seen by reference to Table IV.A., column 8. Still, in view of the large population supplied by these waters, but little importance can be attached to the insignificant record of lead poisoning in connexion with them, except, perhaps, in so far as this might give rise to suspicion, either of more lead poisoning having occurred than has actually been observed, or of the possibility of such slight tendency to act upon lead as these waters have, apparently, hitherto displayed, becoming at some future time increased.

In the case of the Rochdale water, however, the case is different, and it would seem that this water, or some of it, for it is obtained from three different gathering grounds, has at times a vigorous action upon lead. The facts, so far as at present ascertained, are as follows:—In addition to the county borough of Rochdale, that corporation supplies water to a considerable population in the Castleton-by-Rochdale, Littleborough, Milnrow, Whitworth, and Wuerdle and Wardle Urban Sanitary Districts, and a relief supply to the Middleton Urban Sanitary District, which, however, is stated to be seldom used.

As regards the Milnrow District the Medical Officer of Health reports that he has heard of no lead poisoning, and none has been reported to him since his appointment. And from the Castleton-by-Rochdale District it is reported that no lead poisoning which could be attributed to the water in question has come under notice. The Medical Officer of Health to the Middleton District mainly supplied by the Heywood Corporation replies "no cases known definitely about." On the other hand, the Medical Officer of Health to the Rochdale County Borough states that he has had cases of lead poisoning in the past, and also has such at present, though he is unable to speak definitely as to their number. The lead poisoning in Rochdale, which he reports as diminishing, he attributes partly to the ordinary trades of painting and plumbing, but to some extent he evidently regards it as due to the public water supply, for he refers to cases in houses "where the pipe is lead and some distance from "the iron mains." In the Whitworth District lead poisoning is reported as having been "exceedingly common" when the Rochdale water was first used there, but as now diminishing and rare. But from both the Littleborough and Wuerdle and Wardle Districts come accounts of extensive and increasing lead poisoning. In the Wuerdle and Wardle District (estimated population receiving Rochdale water 3,902 out of 3,952) the Medical Officer of Health estimates that 50 cases came under his observation recently, during a period of 12 months: and as regards the Littleborough District the Medical Officer of Health refers to 40 or 50 cases in "two months." The Wuerdle and Wardle District was apparently first supplied with Rochdale water in 1876, and but few cases of lead poisoning were observed until 1884, since which time they have been increasing "and have been mostly continuous during the past two years." Similarly, until 1874, the Littleborough District, although supplied by the

Rochdale Corporation, was supplied with a different water to that now in use—the former being "a very hard water . . . . pumped up from Dearnley "Colliery which was rented by the Rochdale Corporation." And it is reported that up to that time (1874) there was no lead poisoning in the district, neither was any observed until 1878 or 1880; that is, until the present supply had been from four to six years in use—"the pipes apparently "being protected up to that time."

In both these districts the lead poisoning is reported as being most common in the summer and autumn.

As regards the source of the Rochdale water, it appears that it is obtained from three separate moorland gathering grounds, said to be generally similar in character, and situated respectively in the townships of Spotland, Wuerdle and Wardle, and Wardleworth. The water from the Wuerdle and Wardle gathering ground is collected in two reservoirs named Wham and Hamer Pasture, and that from the Spotland gathering ground in two reservoirs named Spring Mill and Cowm. A fifth, "Buckley Wood" reservoir, receives water from "any of the preceding reservoirs," and, apparently, also the water from the Wardleworth gathering ground.

As regards the distribution of these different waters among the several districts supplied by Rochdale, the medical officer of health informs me that "the supply is furnished sometimes from one reservoir, sometimes from "another, and sometimes mixed."

The water in the Cowm reservoir is filtered, the other waters apparently are not filtered.

The Medical Officer of Health to the Littleborough District states that he has examined the water from the Hamer Pasture reservoir (Wuerdle and Wardle gathering ground), with which, he is informed, the Littleborough District is chiefly supplied, and that he finds it has a decidedly acid reaction; whereas he understands that the water from the Cowm reservoir (Spotland gathering ground) is alkaline. To this difference he is inclined to attribute the greater amount of lead poisoning in his district than in some other districts supplied by the Rochdale Corporation.

App. A. No. 18.

In the Course of Lead Poisoning v. Mr. Powell

TABLE IV.A.

NOTING the Water Supplies possessed by COUNTY BOROUGHS in Lancashire, filtered or otherwise treated by the Water Authority and the several together with Data from each Sanitary Area as to circumstances of not of Lead Poisoning in connexion therewith

Name of County Borough Water Supply.	Districts supplied.	Estimated Population receiving the Water.	Source of Water
1.	2.	3	4.
Barrow-in-Furness Corporation Waterworks	Barrow-in-Furness, County Borough.	51,712	Moorland gathering ground 10 miles from Barrow.
	Dalton-in-Furness, U.S.D.	13,300	
		65,012	
Blackburn Corporation Waterworks	Blackburn, County Borough	119,564	Moorland gathering ground at Forest of of Bowland, West Riding of Yorkshire, 20 miles from Blackburn
	Blackburn, R.S.D. (part)	2,320	
		121,884	
Bolton Corporation Waterworks	Bolton, County Borough	115,002	Moorland gathering ground, the Heaton Sharples, Entwistle, and Darwen Moors, 3 to 7 miles from Bolton.
	Aspull, U.S.D. (part)	8,055	
	Astley Bridge, U.S.D.	6,139	
	Atherton, U.S.D. (part)	150	
	Farnworth, U.S.D.	23,758	
	Hindley, U.S.D.	18,973	
	Kearsley, U.S.D.	7,900	
	Leigh, U.S.D.	28,702	
	Little Hulton, U.S.D.	6,697	
	Turton, U.S.D.	4,766	
	Westhoughton, U.S.D.	10,160	
	Barton-upon-Irwell, R.S.D. (part)	8,500	
	Bolton R.S.D.	27,156	
		265,878	

the Source or Sources of each such Supply, whether or not the Water is Sanitary Districts in each instance supplied from the Borough Waterworks; delivery to Consumers of the Water Supply, and Facts as to occurrence or

Whether Filtered or Treated.	Whether Lead Service Pipes are used.	Whether Lead Cisterns are used.	Presence or absence of Lead Poisoning among Consumers according to Reports of Medical Officers of Health.
5.	6.	7.	8.
"Partially"	"To some extent."	No	None heard of.
	No	No	None heard of.
No	Yes, but tinned	Seldom for drinking water.	"None, except what is clearly due to trade." The water said to have a slightly alkaline reaction.
	Yes	—	None heard of.
Yes, most is filtered through sand and gravel.	Yes, but tinned	Not stated	None heard of.
	Yes, but tinned	No	"Cases of lead poisoning very few." Two or three cases in the past due to drinking the water first thing in the morning. (About one-tenth of the population of this district is supplied by the Blackrod Local Board Waterworks.)
	Yes, but tinned	No	None heard of.
	Yes, but tinned	Not stated	None heard of as due to water supply. A few cases of plumbers' colic.
	Yes	No	None heard of.
	Yes	No	None heard of since the use of this water. Previously cases did occur, but then lead-lined cisterns were used.
	Yes, but tinned	No	None heard of.
	Yes, but tinned	No	None heard of as due to drinking water. Two cases in past due to trade.
	Yes	No	None heard of as due to drinking water. Two cases in past due to trade.
	Yes	Very few	None heard of.
	Yes, but tinned	No	None heard of.
	Yes	No	None heard of.
	Yes	No	None heard of.

TABLE IV A.

Name of County Borough Water Supply.	Districts supplied.	Estimated Population receiving the Water	Source of Water.
1	2	3	4.
Burnley Corporation Water-works.	Burnley, County Borough	87,058	Moorland gathering ground 4 miles from Burnley (geologically carboniferous sandstone, in the valleys boulder clay mixed with drift limestone).
Bury Corporation Waterworks.	Bury, County Borough -	57,206	Moorland gathering grounds at Shuttleworth, Haslingden and Clow Bridge—5, 10, and 12 miles from Bury respectively.
	Haslingden, U.S.D. -	17,000	
	Little Lever, U.S.D. -	5,168	
	Prestwich, U.S.D. (part)	3,934	
	Radcliffe, U.S.D. -	20,020	
	Ramsbottom, U.S.D. -	14,000	
	Rawtenstall, U.S.D. -	19,672	
	Whitefield, U.S.D.	10,781	
	Bury, R.S.D. (part) -	12,000	
		159,781	
Liverpool Corporation Water-works.	Liverpool City - -	517,951	Two lands from hill and moorland (millstone grit) between Blackburn and Bolton, 26 miles from Liverpool. One-third from wells in new red sandstone. The waters from the two sources are mixed before delivery in Liverpool, and apparently also before delivery to most of the other districts.*
	Bootle, County Borough	49,217	
	Abram, U.S.D. -	4,239	
	Allerton, U.S.D. -	914	
	Ashton-in-Makerfield, U.S.A.	46	
	Childwall, U.S.D -	199	
	Chorley, U.S.D	23,082	
	Garston, U.S.D.	13,444	
	Great Crosby, U.S.D -	6,109	
	Haydock, U.S.D -	6,509	
	Huyton-with-Roby, U.S.D	4,625	
	Litherland, U.S.D. -	4,441	
	Little Crosby, U.S.D -	212	
	Little Woolton, U.S.D. -	1,131	
	Much Woolton, U.S.D	4,545	
	Prescot, U.S.D -	6,745	
	Toxteth Park, U.S.D -	21,046	
	Walton-on-the-Hill, U.S.D	40,304	
	Waterloo and Seaforth, U.S.D	17,328	
	Wavertree, U.S.D -	13,764	
	West Derby, U.S.D	30,000	
	West Derby, R.S.D -	1,095	
		767,257	

* Since about the end of October 1891 some 3,000,000 gallons of water per Montgomerysshire. This water is mixed with well water and distributed over the

[Lancashire]—*continued.*

Whether Filtered or Treated.	Whether Lead Service Pipes are used.	Whether Lead Cisterns are used.	Presence or absence of Lead Poisoning among Consumers according to Reports of Medical Officers of Health.
5.	6.	7.	8.
No, only stored in reservoirs.	Yes	No	None heard of.
Rubble walls in brook course before entering reservoir.	Yes	Yes	None heard of.
	Yes	No	None heard of.
	Yes	Not stated	None heard of.
	Iron "as far as possible."	No	None heard of as due to water supply.
	Yes	No	None heard of.
	Yes, but tinned	Hardly any	None heard of as due to public water supply.
	Yes, but tinned	Very few	None heard of.
	Yes	No	None heard of as due to public water supply.
	Yes	Only a few	None heard of.
The water from the gathering ground is filtered through sand and gravel. The well water is not filtered.	Yes	Only a few	None heard of as due to water supply.
	Yes	Only a few	None heard of.
	Yes, but most tinned.	No	None heard of.
	Yes	None known of	None heard of.
	Only a few	No	None heard of.
	Yes	Yes, a few	None heard of.
	Yes	Very few, if any.	None heard of as due to water supply.
	Yes	None known of	None heard of.
	Yes	A few	None heard of.
	Only a few	No	None heard of.
	Yes	No	None heard of.
	Yes	A few lead-lined.	None heard of.
	Yes	Yes	None heard of.
	Yes	No	None heard of.
	Yes	No	None heard of.
	Yes	No	None heard of.
	Yes	A few	None heard of.
	Yes	A few	None heard of.
	Yes	Yes	None heard of.
	Yes	Very few	Only one case heard of in connexion with water supply (13 years ago) due to storage of water in leaden cistern.
	Yes	Not many	None heard of as due to water supply.
	Yes	"Few, or none"	None heard of.

day have also been received by the Liverpool Corporation from Vyrnwy Lake, in city but it forms only one seventh of the total supplies. It is filtered.

TABLE IV A.

Name of County Borough Water Supply	Districts supplied	Estimated Population receiving the Water	Source of Water
1	2	3	4
Manchester Corporation Waterworks	Manchester, City	505,343	Gathering ground in the valley of Longdendale Woodhead, 24 miles from Manchester Chiefly moorland resting on the millstone grit. A small portion only is under cultivation.
	Salford, County Borough	198,136	
	Stockport, County Borough	23,419	
	Atherton, U.S.D	15,683	
	Barton Eccles, Winton, and Monton, U.S.D	29,606	
	Crumpsall, U.S.D.*	—	
	Denton and Haughton, U.S.D.	13,793	
	Droylsden, U.S.D	9,482	
	Farnworth, U.S.D. (part)	425	
	Gorton, U.S.D.	15,162	
	Heaton Norris, U.S.D.	7,164	
	Levenshulme U.S.D.	5,566	
	Moss-side, U.S.D	23,833	
	Newton Heath, U.S.D.*	—	
	Openshaw, U.S.D.*	—	
	Prestwich, U.S.D	3,935	
	Reddish, U.S.D	6,854	
	Stretford, U.S.D.	21,751	
	Swinton and Pendlebury, U.S.D.	20,197	
	Tyldesley-with-Shakerley, U.S.D	12,801	
	Withington, U.S.D	25,629	
	Barton-upon-Irwell, R.S.D	17,500	
	Prestwich, R.S.D.	14,705	
		970,924	

* Crumpsall, Newton Heath, and Openshaw Urban Sanitary Districts have that of Manchester above.

Whether Filtered or Treated.	Whether Lead Service Pipes are used.	Whether Lead Cisterns are used.	Presence or absence of Lead Poisoning among Consumers according to Reports of Medical Officers of Health.
5.	6.	7.	8.
	Yes, short ones	No	None heard of as due to this supply.
	Yes, but tinned	Few, if any	None heard of.
	Yes	Seldom for drinking water.	Only one case heard of in 15 years.
	Yes, but tinned	Not stated	None heard of as due to water supply. Only a few cases of plumbers' colic.
	Yes	Some lead-lined	None heard of.
	Yes	No	None heard of as due to water supply.
	Yes	No	None heard of.
	Yes	No	None heard of.
	Yes	No	None heard of as due to water supply.
	Yes	No	None heard of in Gorton, but M.O.H. reports one case met with in another district in connexion with Manchester water.
The water is not filtered, but is passed through wire strainers of 30 strands to the inch.	Yes	No	None heard of.
	Yes	Yes	None heard of
	Yes, short ones	No	None heard of as due to water supply.
	None known of	None known of	None heard of.
	Yes	Not stated	None heard of.
	Iron, "as far as possible."	No	None heard of as due to water supply.
	Yes	No	None heard of.
	Yes	No	None heard of.
	Yes	Yes	"Very few cases having come under my observation either in public or private practice, I can give no approximate estimate. Few, if any complaints have been referred to me for investigation."
	Yes, but tinned	Not stated	None heard of.
	Yes	None known of	None heard of.
	Yes	No	None heard of.
	Yes	None known of	None heard of.

recently been added to the city of Manchester. Their population is included in

TABLE IV A.

Name of County Borough Water Supply.	Districts supplied.	Estimated Population receiving the Water	Source of Water
1	2	3	4
Oldham Corporation Water-works	Oldham, County Borough	131,463	Moorland gathering grounds at Strines-dale, Piethorn, and Denshaw — two, seven, and six miles from Oldham respectively
	Chadderton, U.S.D. -	21,687	
	Crompton, U.S.D. -	12,851	
	Failsworth, U.S.D -	10,000	
	Lees, U.S.D. - -	3,872	
	Royton, U.S.D -	13,395	
	Ashton-under-Lyne, R.S.D. (part)	900	
	Quickmere, U.S.D.* -	2,670	
		196,838	
Preston Corporation Water-works	Preston, County Borough	107,573	1. Moorland gathering ground at Whitewell, 20 miles from Preston 2. High gathering ground, near Longridge
	Longridge, U.S.D -	3,500	
Rochdale Corporation Water-works	Rochdale, County Borough	68,458	Three separate moorland gathering grounds at Spotland, Wuerdle and Wardle, and Wardlesworth respectively, all within a few miles of Rochdale. The different districts supplied by the Rochdale Corporation are served with water "sometimes from one reservoir and sometimes from another and sometimes mixed."
	Castleton-by-Rochdale, U.S.D	4,220	

* In West Riding of Yorkshire. Information

[Lancashire]—*continued.*

Whether Filtered or Treated.	Whether Lead Service Pipes are used.	Whether Lead Cisterns are used.	Presence or absence of Lead Poisoning among Consumers according to Reports of Medical Officers of Health.
5.	6.	7.	8.
	Yes, but many are tinned.	Very few	Very little observed lead poisoning as due to water supply, though the water acts to some extent on lead.
No - -	Yes	Not for drinking purposes.	None heard of as due to water supply.
	Yes, but new ones are tin-lined.	Very few, if any	None heard of.
	Yes	No	None heard of as due to water supply.
	Yes, but generally tin-lined.	Not for domestic supply.	None heard of.
	Yes, but tinned	Not for domestic supply.	None heard of.
	Yes, but tinned	None known of	None heard of.
	Yes	No	None.
Not filtered. Screened. (60 meshes to square inch.)	Yes	No	Almost unheard of in the past. None known of at present.
	No	No	None heard of.
Some of the Spotland water is filtered through sand. Water from other gathering grounds apparently not filtered.	Yes	Yes	Some cases in the past and some at present, "but cannot give any idea of their number." "The cases I have seen have arisen in plumbers and painters, also in houses where the pipe is lead, and some distance from the iron mains."
	Yes	No	None heard of as due to the public water supply.

taken from Dr. Barry's Return.

TABLE IV.

Name of County Borough Water Supply.	Districts supplied.	Estimated Population receiving the Water	Source of Water
1	2	3	4
Rochdale Corporation Waterworks—*cont.*	Littleborough, U.S.D.	9,000	Three separate moorland gathering grounds at Spodland, Wuerdle and Wardle, and Wardleworth respectively all within a few miles of Rochdale. The different districts supplied by the Rochdale Corporation are served with water "sometimes from one reservoir and sometimes from another, and sometimes mixed."
	Middleton, U.S.D.	Relief supply from Rochdale but seldom used	
	Milnrow, U.S.D.	5,364	
	Wheatworth, U.S.D.	4,883	
	Wuerdle and Wardle, U.S.D.	3,902	
		95,827	
St. Helens Corporation Waterworks	St. Helens, County Borough	71,188	Wells in the new red sandstone.
	Ormskirk, R.S.D. (part)	120	
	Prescot, R.S.D. (part)	900	
	West Derby, R.S.D. (part)	115	
		72,323	
Wigan Corporation Waterworks	Wigan, County Borough	54,054	Gathering ground on Haigh Hills, 7 miles from Wigan. Dried old grazing land.

[LANCASHIRE]—*continued.*

Whether Filtered or Treated.	Whether Lead Service Pipes are used.	Whether Lead Cisterns are used.	Presence or absence of Lead Poisoning among Consumers according to Reports of Medical Officers of Health.
5.	6.	7.	8.
Some of the Spotland water is filtered through sand. Water from other gathering grounds apparently not filtered.	Yes	Not for drinking water.	Cases of lead poisoning observed continuously since about 1878 or 1880, and they have been increasing the last three years. "There have been 40 or 50 fresh cases medically attended during the last two months. . . . There are generally more cases of lead poisoning in the summer and autumn than in the winter." Littleborough is said to be supplied mainly from Hamer Pasture reservoir (Wuerdle and Wardle gathering ground).
	Yes	Not for domestic use.	None known definitely about.
	Yes, short ones	No	None heard of.
	Yes	Yes	Lead poisoning "exceedingly common" years ago when the Rochdale Corporation water was first used in this district. It is now rare and diminishing.
	Yes	Only in about 10 houses.	Only a few cases prior to 1884; since then the number has increased. "Mostly continuous during the past two years, but more notably from July to October during that time." "I should say that about 50 cases have come under observation during the past 12 months."
	Yes	Very few	None heard of.
No	Yes	No	None heard of.
	Yes	None known of	None heard of.
	Yes	Few or none	None heard of.
Yes, filtered through sand.	Yes	No	None heard of.

As regards the 14 water supplies provided by Water Companies or Water Trusts, shown in Table V.A., little need at the present stage be said. Most of these waters are derived from upland gathering grounds, but here again, as in the case of the county borough supplies, it would appear that with one exception (the Rossendale Company's supply) there has been no conspicuous lead poisoning among the consumers, at all events during recent years, though there is evidence that certain of the waters do to some extent act, or have in the past acted, upon lead pipes and cisterns. The Rossendale Water Company's supply, however, apparently, as a rule, acts more energetically upon lead than the others now under consideration, and in the spring of 1888 a considerable outbreak of plumbism is reported to have occurred at Bacup in association with this water supply. The somewhat sudden increase in the amount of lead poisoning observed at this time might, it has been suggested,

TABLE V.A.

NOTING with reference to WATER COMPANIES and WATER "TRUSTS" whether or not the Water is Filtered or otherwise "Treated" by the Supply; together with Data for each Sanitary Area as to circumstances or not of Lead Poisoning in connexion therewith.

Name of Water Company.	Districts supplied.	Estimated Population receiving the Water.	Source of Water
1	2.	3.	4
Accrington Gas and Water Company.	Accrington, U.S.D. -	38,603	Gathering grounds, partly moorland, at Dean Clough Valley, 4 miles from Accrington. Lower Reedley, 3 miles from Accrington, and Hapton, half a mile from Accrington.
	Church, U.S.D.	4,870	
	Clayton-le-Moors, U.S.D.	7,355	
	Great Harwood, U.S.D.	9,078	
	Rishton, U.S.D. -	6,010	
	Barnley, R.S.D. -	500	
		66,215	
Ashton-under-Lyne, Stalybridge, and Dukinfield (District) Waterworks Joint Committee.	Ashton-under-Lyne, U.S.D.	40,494	High gathering grounds at Swineshaw 2½ miles from Ashton-under-Lyne and Crowden, 8 miles distant.
	Audenshaw, U.S.D. -	6,547	
	Hurst, U.S.D. - -	6,772	
	Mossley, U.S.D. -	14,162	
	Stalybridge, U.S.D. -	26,783	
	Ashton-under-Lyne, R.S.D. (part).	7,950	
		104,708	
Garstang Waterworks Company.	Garstang and Warton in the Lancaster R.S.D.	2,000	Gathering ground at Scronkey 3 miles distant.
Colne Water Estate Company.	Colne and Marsden U.S.D. (part).	1,592	Hill sides

* Herein are included two minor sources in private lands.

have had some relation to the fact of the water mains having stood empty for a period of six weeks during the previous summer. This water is obtained entirely from moorland gathering grounds, and is stated by Dr. Brown, the Medical Officer of Health to the Bacup Urban Sanitary District, to have an acid reaction. It is not filtered, but in 1888, at the suggestion of Dr. Brown, lime (CaO) was placed across the conduit so that all the water going to the reservoir was charged with $Ca(HO)_2$, which was held in solution. This, however, was discontinued, as the plumbo-solvent action of the water increased.

A few cases of lead poisoning in the past, and one recent case, are reported from districts supplied by the Fylde Company's water; also a few cases are said to have occurred 30 years ago in a district supplied by the Tintwistle Waterworks Company, and one or two cases elsewhere.

[Lancashire.]

in the County of Lancaster, the Source or Sources of each such Supply, Water Authority, and the several Districts in each instance obtaining the of delivery to Consumers of the Water Supply and Facts as to occurrence

Whether Filtered or otherwise Treated.	Whether Lead Service Pipes are used.	Whether Lead Cisterns are used.	Presence or absence of Lead Poisoning among Consumers of the Water according to the Information received from the Medical Officers of Health to the Districts supplied.
5.	6.	7.	8.
In all cases there is provision for settling before admission to the service reservoir.	Yes	No	None heard of, but the water "is capable of taking up lead if long exposed to its action."
The Huncoat water is filtered through sand, gravel, coke, and bricks.	Yes	No	None heard of.
	Yes	No	None heard of.
	Yes	No	None heard of.
	Yes	No	None heard of.
	Yes	No	None heard of.
No	Yes, but many are tin-lined.	Yes	None heard of.
	Yes	No	None heard of.
	Yes, but some tin-lined.	No	None heard of.
	Yes, but tin-lined.	Not many	Only two cases heard of in 15 years. None at present.
	Yes	—	None heard of.
	Yes, but some are tin-lined.	No	None heard of.
No	Some, but chiefly iron.	—	None heard of.
No	Yes	Very few	None heard of.

both of them delivered to Colne and Marsden U.S.D.

TABLE V A

Name of Water Company	Districts supplied	Estimated Population supplied with the Water	Source of Water
1	2	3	4
Fylde Water-works Company, The	Blackpool, U.S.D.	23,596	Gravitation from Lunds, 14 miles from source of The Fylde R.S.D.
	Fleetwood, U.S.D.	9,274	
	Kirkham, U.S.D.	3,889	
	Lytham, U.S.D.	4,636	
	St. Anne's, U.S.D.	2,538	
	The Fylde, R.S.D.	8,110	
	Garstang, R.S.D.	3,256	
		55,299	
London and North-Western Railway Company's Supply.	Newton-in-Makerfield, U.S.D.	12,000	Deep bore-holes in the coal measures.
Montcliffe Colliery Supply.	Horwich, U.S.D.	200 supplied with this water alone; 12,500 with mines and Bracknell Local Board water mixed.	- -
Lossendale Water-works Company.	Bacup, U.S.D. -	4,240	Moorland gathering ground within the Bacup U.S.D.
Mr. Ormerod's supply.	Crime and Marsden, U.S.D.	100	Agricultural land near Crime.

Whether Filtered or otherwise Treated.	Whether Lead Service Pipes are used.	Whether Lead Cisterns are used.	Presence or absence of Lead Poisoning among Consumers of the Water according to the Information received from the Medical Officers of Health to the Districts supplied.
5.	6.	7.	8.
Passed through fine sieves having 10,000 apertures to the square inch.	Yes	Not for domestic use.	Rare cases occasionally in the past; practically none. One case recently in new house attributed to new lead service pipe.
	Yes	Not for domestic use.	None heard of.
	Yes	Not for domestic use.	None heard of as due to water supply.
	Yes	Apparently not now.	In the past very few cases. Unprotected lead cisterns once the cause, but now done away with. No lead poisoning at present.
	Yes	Not for domestic use.	None heard of.
	Yes	Not for domestic use.	None heard of as due to the Company's water.
	Yes	Very few	None traced to The Fylde Company's water.
No - - -	Yes	Yes	None heard of.
No - - - -	Yes, but tin-lined.	No	None heard of.
Not filtered, but passed through settling wells.	Yes, short lengths.	Not for drinking purposes.	In the spring of 1888, there was a considerable outbreak of plumbism, which "was associated with the public water supply." This followed upon a water famine in the previous year, when the pipes were empty for six weeks. "But there were cases of lead palsy due to public water supply for many years past." On the whole, however, it seems to be diminishing, and at present there are only a few cases.
Apparently not -	Yes - -	Very few -	None heard of.

Of the 22 water supplies possessed by urban sanitary authorities, other than county boroughs (Table VI.A.), there is little to record as regards lead poisoning. Two or three cases are reported as having, in the past, occurred in the Aspull Urban Sanitary District, which obtains some of its water from the Blackrod Local Board Waterworks. Aspull, however, obtains most of its supply from the Bolton Corporation Waterworks, and it is not stated to which water the cases were apparently due. In the other five districts to which the Blackrod Local Board water is also supplied, no lead poisoning has been observed. In connexion with the Darwen Corporation water, there has evidently been an appreciable amount of lead poisoning in the past, though it appears now to have diminished. The medical officer reports as follows:—"Cases of lead "poisoning having occurred for some years past in the district, samples of "water were sent about two years ago to Dr. Frankland, who recommended "a quantity of soda to be put into the water. This was done, and I have "not heard of a case of lead poisoning since." The Darwen water is obtained from hills near the borough.

From the Skelmersdale Urban Sanitary District "several cases of lead colic "and two well-marked cases with palsy," evidently considered by the Medical Officer of Health to have been due to the public water supply provided by the Skelmersdale Local Board, are reported. The Medical Officer of Health adds that he "recommended the local board to take up the long lengths of lead "pipes, which was carried out." The lead poisoning, he states, is diminishing. This water is obtained from an artesian well in the red sandstone. It is not filtered.

TABLE VI.A.

NOTING the Water Supplies possessed by URBAN SANITARY DISTRICTS such Supply, whether or not the Water is Filtered or otherwise Treated by obtaining the Supply; together with Data for each Sanitary Area as to to the occurrence or not of Lead Poisoning in connexion therewith.

Name of Urban Sanitary District Water Supply.	Districts supplied.	Estimated Population receiving the Water.	Source of the Water.
1.	2.	3.	4.
Ashton-in-Makerfield Local Board Waterworks	Ashton-in-Makerfield, U.S.D.	10,800	Gathering ground—agricultural land—within the district and partly from adjoining township of Winstanley
Bilinge Local Board Waterworks	Bilinge, U.S.D.	3,866	Disused quarry workings

One case, and one only, of lead poisoning is mentioned as having come under observation in the Widnes Urban Sanitary District. This district is supplied with water from deep wells by the Widnes Local Board Waterworks.

With the possible exceptions above referred to, there is no evidence of lead poisoning, either in the past or at present, in connexion with the public water supplies possessed by any of the 22 urban sanitary authorities. The waters are obtained from various sources, but the majority are from upland gathering grounds, and several of such waters are not filtered or otherwise treated. It will be observed that the Heywood Corporation water is obtained from a gathering ground at Nayden Dean, in the township of Spotland, in which township one of the gathering grounds of the Rochdale Corporation water is also situated. The Heywood water is supplied to over 47,000 persons in six sanitary districts, and it seems evident that no conspicuous lead poisoning has occurred as a result of its use. In one of these five districts, Castleton-by-Rochdale, some cases have been met with, but they do not appear to have been attributed to public water supply. From another district, Middleton, it is stated that no cases are known "definitely about," a remark which would seem to imply a suspicion that cases have occurred. It will be noted, however, that the former of these districts is almost entirely supplied by the Rochdale Corporation, only about 120 persons receiving the Heywood supply, and that the latter, although mainly supplied with the Heywood Corporation water, yet has a relief supply from Rochdale.

[Lancashire.]

(other than County Boroughs) of Lancashire, the Source or Sources of each the Water Authority, and the several Sanitary Districts in each instance circumstances of delivery to Consumers of the Water Supply, and Facts as

Whether Filtered or otherwise Treated.	Whether Lead Service Pipes are in use.	Whether Lead Cisterns are in use.	Presence or absence of Lead Poisoning among Consumers according to Information supplied by the Medical Officers of Health.
5.	6.	7.	8.
Yes. Filtered through sand and gravel.	Only a few, and those tinned.	None known of	None heard of.
Yes. Filtered through broken stones and sand, &c.	No	No	None heard of.

TABLE VI c.

Name of Urban Sanitary District Water Supply.	Districts supplied.	Estimated Population receiving the Water.	Source of the Water.
1.	2.	3.	4.
Blackrod Local Board Waterworks.	Blackrod, U.S.D. -	4,021	Gathering ground—Rivington Hills—three miles distant.
	Adlington, U.S.D. -	4,190	
	Aspull, U.S.D. (part) -	897	
	Horwich, U.S.D. -	12,500*	
	Chorley, R.S.D. (part) -	150	
	Wigan, R.S.D. (part) -	1,186	
		22,944	
Clitheroe Corporation Waterworks.	Clitheroe, U.S.D.	10,600	Grit Fells, forming part of north-western boundary of Ribble Valley, 2 to 3 miles from Clitheroe.
Colne and Marsden Local Board Waterworks.	Colne and Marsden, U.S.D.	15,131	Moorlands partly within district.
Darwen Corporation Waterworks.	Darwen, U.S.D. -	32,692	Hills near the borough.
Fulwood Local Board Waterworks.	Fulwood, U.S.D. -	4,006	Beacon Fell, 11 miles from Fulwood.
	Preston, R.S.D. (part) -	600	
		4,606	
Grange Local Board Waterworks.	Grange, U.S.D. -	1,633	Newton Hills, 4 miles distant.
	Kendal, R.S.D. (part) -	400	
		2,033	

* Supplied with Blackrod and

[Lancashire]—*continued.*

Whether Filtered or otherwise Treated.	Whether Lead Service Pipes are in use.	Whether Lead Cisterns are in use.	Presence or absence of Lead Poisoning among Consumers according to Information supplied by the Medical Officers of Health.
5.	6.	7.	8.
No	Yes, but tinned	- - -	None heard of.
	A few	A few	None heard of.
	Yes, but tinned	No	"Cases of lead poisoning are very few." Two or three cases have been observed in the past, and "each case was traced to the habit of drinking from the tap immediately on rising in the morning before going to work." It is not stated whether these were persons using the Blackrod or Bolton water.
	Yes, but tinned	No	None heard of.
	No	No	None heard of.
	Yes, but tinned	- - -	None heard of.
No - - -	Yes, but tinned	No	None heard of.
No - - -	Yes	Very few	None heard of.
Filtering beds just completed. The water is also treated with soda.	Yes	- - -	Cases of lead poisoning have occurred for some years past, but have not been observed since treatment of the water with soda was adopted.
No - -	Yes	No	None heard of.
	Yes	None known of	None heard of.
No - -	No	No	None heard of.
	No	Very few	None heard of.

Montcliffe Colliery water mixed.

TABLE VI.A.

Name of Urban Sanitary District Water Supply.	Districts supplied.	Estimated Population supplied with the Water	Source of the Water
1	2.	3.	4.
Heywood Corporation Waterworks.	Heywood, U.S.D. -	23,286	Gathering ground at Nayden Dean, in the township of Spotland, near Rochdale. About 5 miles from Heywood.
	Castleton-by-Rochdale (part).	120	
	Chadderton, U.S.D. -	200	
	Middleton, U.S.D. -	21,110	
	Norden, U.S.D. -	2,400	
	Prestwich, R.S.D. -	765	
		47,941	
Ince Local Board Waterworks.	Ince-in-Makerfield, U.S.D.	19,255	Well in the red sandstone.
	Leigh, R.S.D. -	5,000	
		24,255	
Lancaster Corporation Waterworks.	Lancaster, U.S.D. -	31,038	Gathering ground at Over Wyresdale, 8 miles distant.
	Morecambe, U.S.D. -	6,476	
	Lancaster, R.S.D. (part)	3,200	
		40,714	
Leyland Local Board Waterworks.	Leyland, U.S.D. -	4,000	Deep well -
Nelson Corporation Waterworks.	Nelson, U.S.D. - -	22,700	Two moorland gathering grounds [illegible] Springs. About 4 and 4½ miles from Nelson.
	Brierfield, U.S.D. -	5,838	
	Burnley, R.S.D. (part) -	3,000	
		31,538	
Ormskirk Local Board Waterworks.	Ormskirk, U.S.D. -	6,298	Pumped from red sandstone.
	Lathom, U.S.D. -	55	
	Ormskirk, R.S.D. (part)	475	
		6,828	
Oswaldtwistle Local Board Waterworks.	Oswaldtwistle, U.S.D. -	13,266	Gathering ground in the north-west of the district.
	Church, U.S.D. (part) -	1,000	
		14,266	

[LANCASHIRE]—*continued.*

Whether Filtered or otherwise Treated.	Whether Lead Service Pipes are in use.	Whether Lead Cisterns are in use.	Presence or absence of Lead Poisoning among Consumers according to Information supplied by the Medical Officers of Health.
5.	6.	7.	8.
Yes, filtered through broken stone and sand.	Yes	Yes	None heard of.
	Yes	No	None heard of as due to water supply.
	Yes	Not for drinking purposes.	None heard of as due to water.
	Yes	Not for domestic use.	"No cases known definitely about."
	Yes	No	None heard of.
	Yes	None known of	None heard of.
No - -	Yes, some	No	None heard of.
	About 15 per cent. lead, the rest iron.	No	None heard of.
No - - -	Yes	Yes	None heard of.
	Yes	Not for drinking purposes.	None heard of.
	Some, but chiefly iron.	- - -	None heard of.
No - - -	Yes, but tin-lined.	- - -	None heard of.
No - - -	Yes	No	None heard of. (The water said not to act on lead.)
	Yes	No	None heard of.
	Yes	No	None heard of.
No - - -	Yes	Some	None heard of.
	Yes	No	None heard of.
	Yes	No	None heard of.
No - - -	Yes	No	None heard of.
	Yes	No	None heard of.

TABLE VI.a

Name of Urban Sanitary District Water Supply.	Districts supplied.	Estimated Population receiving the Water	Source of the Water
1	2	3.	4.
Padiham and Hapton Local Board Waterworks.	Padiham and Hapton, U.S.D.	11,311	Gathering ground at Pendle Hill, about 2½ miles from Padiham
Pemberton Local Board Waterworks.	Pemberton, U.S.D. -	18,000	Old quarries at Billinge and Upholland
	Orrell, U.S.D. - -	4,914	
		22,914	
Skelmersdale Local Board Waterworks.	Skelmersdale, U.S.D. -	6,627	Well in the red sandstone.
	Lathom, U.S.D. (part) -	150	
	Ormskirk, R.S.D. (part)	175	
		6,952	
Ulverstone Local Board Waterworks.	Ulverstone, U.S.D. -	9,848	Moorland gathering ground at Pennington Moor, 3 miles distant
	Ulverstone, R.S.D. -	300	
		10,148	
Walton-le-Dale Local Board Waterworks.	Walton-le-Dale, U.S.D.	9,070	Deep well -
	Chorley, R.S.D. (part) -	140	
	Preston, R.S.D. (part) -	200	
		9,410	
Warrington Corporation Waterworks.	Warrington, U.S.D -	52,742	Wells in the red sandstone
	Warrington, R.S.D. (part).	1,900	
		54,642	
Widnes Local Board Waterworks.	Widnes, U.S.D -	29,911	Deep wells - -
	Prescot, R.S.D. -	1,250	
		31,161	

[Lancashire]—*continued.*

Whether Filtered or otherwise Treated.	Whether Lead Service Pipes are in use.	Whether Lead Cisterns are in use.	Presence or absence of Lead Poisoning among Consumers according to Information supplied by the Medical Officers of Health.
5.	6.	7.	8.
Screened	Yes	No	None heard of.
Filtered through sand and gravel.	Yes, but tin-lined.	Not stated	None heard of.
	Yes, but tin-lined.	No	None heard of.
No	Yes	No	"There were several cases of lead colic and two well-marked cases with palsy. . . . Recommended the Local Board to take up the long lengths of lead-pipes which was carried out." Lead poisoning diminishing.
	Yes	No	None heard of.
	Yes	No	None heard of.
Not filtered, passed through copper screens.	No	Yes, in many cases.	None heard of.
	No	No	None heard of.
No	Yes	No	None heard of in the township.
	No	No	None heard of.
	Yes	None known of	None heard of.
No	Yes	Not for drinking purposes.	None heard of.
	No	No	None heard of.
No	Yes	Yes	Only one case heard of in the last 10 years.
	Yes	None known of	None heard of.

Table VII.a., relating to the water supplies possessed by, or

TABLE VII.a.

NOTING the Water Supplies possessed by, or provided for, RURAL SANITARY such Supply, whether or not the Waters are Filtered before delivery, and together with Data for each such Place or Locality as to circumstances Lead Poisoning in connexion therewith.

Name of Rural Sanitary District Public Water Supplies.	Localities supplied.	Estimated Population receiving the Water.	Source of Water.
1.	2.	3.	4.
Burnley, R.S.D.:			
a. Haggate supply.	Haggate village -	1,000	Moorland spring with tank to hold a day's supply.
b. Hapton supply.	Hapton village - -	2,000	
c. Cliviger supply.	Cliviger village -	600	
		3,600	
Clitheroe, R.S.D.:			
a. Whalley supply.	Whalley - -	700	Hill gathering ground
b. Sabden supply.	Sabden - - -	600	
c. Downham and Chatburn supply.	Chatburn and Downham	600	
d. Pendleton -	Pendleton - -	100	
		2,000	
Lunesdale, R.S.D.:			
a. Wray water scheme.	Wray and Horuby -	365	Hill gathering ground -
b. Caton water scheme.	Caton and Brookhouse -	820	Springs - -
c. Halton water scheme.	Halton - - -	250	Surface drainage -
		1,435	
Prescot, R.S.D.:			
a. Rainhill supply.	Rainhill and part of Whiston.	4,235	Wells in the new red sandstone
b. Hale supply	Hale - - -	571	
		4,806	
Preston, R.S.D.:			
Messrs. Bashall's supply.	Farington -	1,156	Well - -

[The aggregate population shown in column 3 of Tables IV.a, V.a, VI.a and persons owing to the fact that the first-named tables, in which water supplies are 400 persons in the Kendal R.S.D. (Westmorland) who obtain their water from whereas Tables I.a, II.a, and III.a, in which sanitary districts are the governing Lancashire.]

provided for, rural sanitary authorities seem to require no comment.

[Lancashire.]

Authorities, in the County of Lancaster, the Source of Sources of each the Townships, Localities, or Places in each instance obtaining the Supply; of delivery to Consumers of the Water, and Facts as to occurrence or not of

Whether Filtered or otherwise Treated.	Whether Lead Pipes are used.	Whether Lead Cisterns are used.	Presence or absence of Lead Poisoning among the Consumers according to Information supplied by the Medical Officers of Health.
5.	6.	7.	8.
No	-	-	None heard of.
No	Yes, short lengths.	No	"Have only seen three cases of lead poisoning in 18 years; two were painters."
Filtered through gravel. Not filtered as a rule, but sometimes. Not stated	Some; but tin-lined.	No	None heard of.
No	Yes	None known of.	None heard of.
No	Yes	None known of.	None heard of.

VII.A exceeds that given in column 5 of Tables I.A, II.A, and III.A, by 3,070 the governing units, include 2,670 persons in the Quickmere U.S.D. (Yorkshire) and Lancashire sources (Oldham Corporation and Grange Local Board respectively); units, include only sanitary districts situate wholly or partly in the county of

(2.) Cumberland.

Preliminary information having reference to water supplies and [illegible] in connexion therewith, has been received from the 14 urban and 9 rural sanitary districts in the county of Cumberland. These 23 districts have an aggregate area of about 970,154 acres, and a population of some 265,[illegible] persons.

Of the total population it is estimated that 174,091 persons, or about [illegible] per cent., obtain water from some public source, while the remaining 91,5[illegible] or 34 per cent., are dependent upon private sources of supply.

A.—Water Supplies: Public and other.

In Table II.B.* will be found, with respect to the 14 urban sanitary districts in the county of Cumberland, the general data as to area and population; and also the estimated number of persons receiving water from a public service, and of those dependent upon private sources of supply. From this table it appears that of an aggregate population of 150,047 persons, it is estimated that 145,089, or nearly 97 per cent., obtain their water from some public service, while the remaining 4,958, or rather over 3 per cent., are dependent upon private sources.

Table II.B. [Cumberland.]

Summary of Returns with respect to the Water Supply of the 14 Urban Sanitary Districts situate in the County of Cumberland.

Name of Urban Sanitary District.	Area in Acres. (1881 Census Report.)	Population, 1881. (Preliminary Census Report, 1881.)	Population, 1881. (Preliminary Census Report, 1881.)	In Urban Districts having Public Water Supply. Estimated Population.		Persons [illegible] Urban Districts wholly dependent upon Private Sources of Supply.
				Served from Public Source.	Dependent on Private Sources.	
1	2.	3	4.	5	6	7
Arlecdon and Frizington	3,251	6,[illegible]	5,5[illegible]	5,5[illegible]	96	—
Carlisle	1,[illegible]	36,[illegible]	39,[illegible]	39,[illegible]	—	—
Cleator Moor	2,947	10,[illegible]	9,[illegible]	9,[illegible]	—	—
Cockermouth	2,429	5,[illegible]	5,[illegible]	5,[illegible]	—	—
Egremont	2,743	6,[illegible]	6,[illegible]	6,[illegible]	—	—
[illegible]ington	2,[illegible]	3,[illegible]	3,[illegible]	3,[illegible]	[illegible]	—
Holme Cultram	23,[illegible]	4,[illegible]	4,[illegible]	—	—	4,[illegible]
Keswick	784	3,[illegible]	5,[illegible]	5,[illegible]	—	—
Maryport	2,827	8,[illegible]	8,[illegible]	8,[illegible]	—	—
Millom	1,[illegible]	6,[illegible]	5,[illegible]	5,[illegible]	—	—
Penrith	7,[illegible]	9,[illegible]	8,[illegible]	8,[illegible]	—	—
Whitehaven	[illegible]	19,[illegible]	18,[illegible]	18,[illegible]	—	—
Wigton	575	3,[illegible]	3,[illegible]	3,[illegible]	—	—
Workington	811	4,[illegible]	2,[illegible]	2,[illegible]	[illegible]	—
Total	53,[illegible]	1[illegible],[illegible]	1[illegible],[illegible]	145,089	[illegible]	[illegible]

In Table III.B. are given similar data for the nine rural sanitary districts, from which it will be found that out of an aggregate estimated population of 115,[illegible] persons, it is computed that only 2[illegible] or 2[illegible] per cent. of the inhabitants are at present supplied with water by any public service, while as many as 9[illegible] or approximately 75 per cent. of the whole are still dependent upon local sources of supplies.

* There being no county boroughs in the county of Cumberland there is no material for [illegible]

TABLE III.B. [CUMBERLAND.]

SUMMARY of RETURNS with respect to the Water Supply of the 9 RURAL SANITARY DISTRICTS situate in the County of Cumberland.

Name of Rural Sanitary District.	Area in Acres. (1881 Census Report.)	Census Population, 1881.	Estimated Population, 1890.	In Rural Districts having Public Water Supply. Estimated Population		Population of Rural Districts wholly dependent on Private Sources of Supply.
				Served from Public Source.	Dependent on Private Sources.	
1.	2.	3.	4.	5.	6.	7.
Alston with Garrigill	36,968	4,621	4,188	2,450	1,738	—
Bootle - -	89,988	5,997	3,000	200	2,800	—
Brampton - -	97,705	10,565	10,500	3,100	7,400	—
Carlisle - -	67,596	16,378	16,378	900	15,478	—
Cockermouth -	163,528	26,782	29,445	13,200	16,245	—
Longtown - -	88,245	7,711	7,950	—	—	7,950
Penrith - -	180,674	13,974	12,750	2,300	10,450	—
Whitehaven - -	78,729	14,093	15,865	6,052	9,813	—
Wigton - -	113,222	15,262	15,500	800	14,700	—
Total -	916,655	115,383	115,576	29,002	78,624	—

B.—PUBLIC WATER SUPPLIES AND LEAD POISONING.

In Tables V.B.* to VII.B. will be found an analysis of the circumstances as regards source, delivery, and distribution of the public water supplies in the county of Cumberland; together with information as to the presence or absence of lead poisoning in connexion with such supplies.

The majority of the supplies distributed to urban sanitary districts (Tables V.B. and VI.B.) appear to be obtained directly from mountain gathering grounds, though three important ones are taken from rivers, and one from a lake. Of the three supplies from rivers, two, viz., the Carlisle Corporation supply, and the supply of the Trustees of the District and Harbour of Maryport, are filtered; but the Penrith Local Board Supply, from the River Eamont, is not at present filtered. The supplies provided for rural sanitary districts (Table VII.B.) are for the most part obtained from springs upon the neighbouring hills.

As regards lead poisoning the evidence from Cumberland is almost entirely negative. It will, however, be noted that for some or other reason, according to the information received, very few lead service pipes or cisterns are used in Cumberland.

The only cases of lead poisoning reported from Cumberland occurred in districts supplied by the Whitehaven Local Board Waterworks and the Wigton Local Board Waterworks. As regards the former district, the Medical Officer of Health says he is informed that "symptoms of lead poisoning occurred in "former years when lead cisterns were used, but these have now been disused "for many years, and I can get no reliable account of any cases of lead "poisoning due to water in recent years." The Whitehaven Local Board water is obtained from Ennerdale Lake. It is not filtered. Lead service pipes appear to be still in use in houses to which this water is distributed.

In the case of Wigton the Medical Officer of Health reports one case of colic in a painter, and one case of "wrist-drop" of some years' standing. The latter, however, he says, presents no other symptoms of lead poisoning, and no source of lead poisoning could be found—"the water used was free from lead."

* There being no county boroughs in the county of Cumberland there is no material for Table IV.B.

TABLE V.B

NOTING with reference to WATER COMPANY (or WATER TRUST) in the water is Filtered or otherwise Treated by the Water Authority, and the Sanitary Area as to circumstances of delivery to Consumers of the Water therewith.

Name of Water Company or Trust.	Districts supplied.	Estimated Population receiving the Water.	Source of the Water.
1	2	3	4
Cockermouth and Workington Joint Waterworks Committee.	Cockermouth, U.S.D. -	5,464	Mountain gathering ground near Crummock Lake, 7 miles from Cockermouth.
	Harrington, U.S.D. -	3,475	
	Workington, U.S.D. -	23,322	
	Cockermouth, R.S.D. (part).	[illegible]	
	Whitehaven, R.S.D. (part).	325	
		40,586	

TABLE VI.B.

NOTING the Water Supplies possessed by URBAN SANITARY DISTRICTS in the or not the Water is Filtered or otherwise Treated by the Water Authority, together with Data for each Sanitary Area as to circumstances of delivery Lead Poisoning in connexion therewith.

Name of Urban Sanitary District Water Supply.	Districts supplied.	Estimated Population receiving the Water.	Source of Water.
1	2	3	4
Arlecdon and Frizington Local Board Waterworks.	Arlecdon and Frizington, U.S.D.	[illegible]	Mountain gathering ground around the Cogra Valley, 5 miles distant.
	Egremont, U.S.D. -	6,243	
	Whitehaven, R.S.D. (part).	[illegible]	
		[illegible]	
Carlisle Corporation Waterworks.	Carlisle, U.S.D. -	39,176	The River Eden -
	Carlisle, R.S.D. -	900	
		[illegible]	

[CUMBERLAND.]

County of Cumberland, the Source or Sources of Supply, whether or not the several Sanitary Districts obtaining the Supply; together with Data for each Supply, and Facts as to occurrence or not of Lead Poisoning in connexion

Whether Filtered or otherwise Treated.	Whether Lead Service Pipes are used.	Whether Lead Cisterns are used.	Presence or absence of Lead Poisoning among Consumers of the Water according to Information received from the Medical Officers of Health to the Districts supplied.
5.	6.	7.	8.
No	No	No	None heard of.
	Practically, no	No	None heard of.
	Yes	Yes?	None heard of, but the water said to have a powerful action on lead and iron.
	Practically, no	No	None heard of.
	No	Not as a rule	None heard of.

[CUMBERLAND.]

County of Cumberland, the Sourse or Sources of each such Supply, whether and the several Sanitary Districts in each instance obtaining the Supply; to Consumers of the Water Supply, and Facts as to the occurrence or not of

Whether Filtered or otherwise Treated.	Whether Lead Service Pipes are used.	Whether Lead Cisterns are used.	Presence or absence of Lead Poisoning among Consumers according to Information supplied by the Medical Officers of Health.
5.	6.	7.	8.
No	No	No	None heard of.
	No	No	None heard of.
	A few	Not as a rule	None heard of.
Yes, filtered through boulders, pebbles, gravel, and sand.	Yes	No	None heard of.
	Yes	No	None heard of.

TABLE VI B.

Name of Urban Sanitary District Water Supply	Districts supplied	Estimated Population receiving the Water	Source of Water
1.	2.	3.	4.
Cleator Moor Local Board Waterworks.	Cleator Moor, U.S.D.	9,464	Hill gathering ground from [illegible] miles east of the district
	Whitehaven, R.S.D. (part).	1,417	
		10,881	
Keswick Local Board Waterworks.	Keswick, U.S.D.	3,905	Soles of Skiddaw, 2 miles from Keswick.
	Cockermouth, R.S.D. (part).	200	
		4,105	
Trustees of the Harbour and Harbours of Maryport.	Maryport, U.S.D.	8,784	River Derwent
	Cockermouth, R.S.D. (part).	5,000	
		13,784	
Millom Local Board Waterworks	Millom, U.S.D.	8,806	Hill gathering ground [illegible] and part of Water [illegible] about 6 miles from Millom.
Penrith Local Board Waterworks	Penrith, U.S.D.	8,080	River Lowther.
Whitehaven Local Board Waterworks	Whitehaven, U.S.D.	18,844	Ennerdale Lake, 8 miles distant.
	Whitehaven, R.S.D. (part).	1,210	
		20,054	
Wigton Local Board Waterworks	Wigton, U.S.D.	3,850	Spring on the Lake [illegible] Hills, 4 miles from Wigton.

[Cumberland]—*continued.*

Whether Filtered or otherwise Treated.	Whether Lead Service Pipes are used.	Whether Lead Cisterns are used.	Presence or absence of Lead Poisoning among Consumers according to Information supplied by the Medical Officers of Health.
5.	6.	7.	8.
Yes, filtered through gravel and sand.	No, except in a few instances.	No	None heard of.
	A few, mostly galvanised iron.	Not as a rule	None heard of.
No	No	No	None heard of.
	Practically, no	No	None heard of.
Filtered through gravel.	No	No	None heard of.
	Practically, no	No	None heard of.
No	No	No	None heard of.
No	No	No	None heard of.
No	Yes	Very few	None heard of in recent years, but said to have occurred "in former years" when lead cisterns were used.
	Only a few	Not as a rule	None heard of.
No	Very few	No	Apparently none heard of as due to water supply.

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TABLE VII.g

NOTING the Water Supplies possessed by or provided for RURAL SANITARY Districts, whether or not the Waters are Filtered or otherwise Treated before use, Supply; together with Data for each such Place or Locality as to occurrence or not of Lead Poisoning in connexion therewith.

Name of Rural Sanitary District Water Supply.	Districts supplied	Estimated Population receiving the Water	Source of Water
1.	2	3.	4
Alston with Garrigill, R.S.D.:			
a. Alston supply	Alston - - -	1,050	"Springhead" -
b. Nenthead supply (East).	Nenthead (part) -	600	All springs from the fells
c. Nenthead supply (West).	Nenthead (part) -	400	
d. Garrigill supply (1).	Garrigill (part) -	400	
e. Garrigill supply (2).	Garrigill (part) -		
		2,450	
Bootle, R.S.D.: Silecroft water supply.	Silecroft - -	200	High upland slopes -
Brampton, R.S.D.:			
a. Brampton supply.	Brampton - -	2,000	All hill springs -
b. Midgeholme supply.	Midgeholme - -	400	
c. Spelter works supply.	Spelter works - -	500	
d. Talkin supply.	Talkin - - -	200	
		3,100	
Penrith, R.S.D.:			
a. Langwathby supply.	Langwathby - -	300	All from springs, except Blencarn, which is from a small stream.
b. Ainstable supply.	Ainstable - -	150	
c. Great Salkeld supply.	Great Salkeld - -	200	
d. Skirwith supply.	Skirwith - -	400	
e. Blencarn supply.	Blencarn - -	150	
f. Croglin supply.	Croglin - -	200	
g. Threlkeld supply.	Threlkeld - -	300	
h. Lazonby supply.	Lazonby - -	600	
		2,300	

DISTRICTS in the County of Cumberland, the Source or Sources of each such delivery, and the Townships, Localities, or Places in each instance obtaining circumstances of delivery to Consumers of the Water, and Facts as to the

Whether Filtered or otherwise Treated.	Whether Lead Service Pipes are in use.	Whether Lead Cisterns are in use.	Presence or absence of Lead Poisoning among Consumers according to Information supplied by the Medical Officers of Health.
5.	6.	7.	8.
No - -	Yes	Very few	None heard of as due to water supply.
No - - -	No	No	
No, only stored in reservoir.	No	No	None heard of.
No - -	Yes	No	None heard of.
Blencairn water is filtered through sand and gravel. The rest are untreated.	No	No	None heard of.

TABLE VII.

Name of Rural Sanitary District Water Supply.	Districts supplied.	Estimated Population receiving the Water	Source of Water
1.	2.	3.	4.
Whitehaven. R.S.D.			
a. Parton supply.	Parton - -	1,600	Local springs - -
b. Moresby supply.	Moresby (part) -		
Wigton. R.S.D. : Three small villages have separate supplies, with standpipes at different points.	*a* - - -	150	- -
	b. - - -	150	
	c. - - -	200	
		850	

[Cumberland]—*continued.*

Whether Filtered or otherwise Treated.	Whether Lead Service Pipes are in use.	Whether Lead Cisterns are in use.	Presence or absence of Lead Poisoning among Consumers according to Information supplied by the Medical Officers of Health.
5.	6.	7.	8.
No	No	No	None heard of.
No	No	No	None heard of.

(3) Westmorland.

Information with respect to water supplies, and lead poisoning in connexion therewith, has been received from seven urban and three rural sanitary districts in the county of Westmorland. The 10 districts in question have collectively an area of about 503,073 acres, and a population of some 66,538 persons.

Of the total population it is estimated that 27,324 persons, or about 41 per cent., obtain water from some public service, while the remaining 39,214, or practically 59 per cent., are dependent upon private sources of supply.

A.—Water Supplies: Public and other.

In Table II.c.* will be found, with respect to the seven urban sanitary districts in the county of Westmorland, the general data as to area and population; and the estimated number of persons respectively supplied with water by a public service, and of those dependent upon private sources of supply.

From this table it appears that of the aggregate population of 24,950 persons it is estimated that 24,242, or 97 per cent. of the whole, are supplied by one or other of the public services, while the remaining 708, or rather less than 3 per cent., are dependent upon private sources of supply.

Table II.c. [Westmorland.]

Summary of the Returns with respect to the Water Supply of the 7 Urban Sanitary Districts situate in the County of Westmorland.

Name of Urban Sanitary District.	Area in Acres. (1881 Census Report.)	Population, 1881, (Preliminary Census Report, 1891.)	Population, 1891. (Preliminary Census Report, 1891.)	In Urban Districts having Public Water Supply. Estimated Population		Populations of Urban Districts wholly dependent on Private Sources of Supply
				Served from Public Source.	Dependent on Private Sources.	
1.	2.	3.	4.	5.	6.	7
Ambleside - -	4,371	1,989	2,360	2,300	60	—
Appleby - -	1,855	1,855	1,776	1,776	—	—
Bowness - -	995	1,855	2,062	2,000	62	—
Grasmere - -	3,013	684	1,016	986	30	—
Kendal - -	2,622	13,696	14,430	14,430	—	—
Kirkby Lonsdale -	3,254	1,733	1,802	1,500	302	—
Windermere -	100	1,269	1,504	1,250	254	—
Total -	16,210	23,081	24,950	24,242	708	—

In Table III.c. are given similar data for the three rural sanitary districts, and as regards these districts it appears that out of an aggregate estimated population of 41,588 persons, it is computed that only 3,082, or 7 per cent., receive water from public sources, while the enormous majority of 38,506, or nearly 93 per cent., are entirely dependent upon private and local supplies.

* There being no county boroughs in Westmorland there is no material for Table I.c.

Table III.c. [Westmorland.]

Summary of the Returns with respect to the Water Supply of the 3 Rural Sanitary Districts in the County of Westmorland.

Name of Rural Sanitary District.	Area in Acres. (1881 Census Report.)	Census Population, 1881.	Estimated Population, 1890.	In Rural Districts having Public Supply, Estimated Population		Population of Rural Districts wholly dependent on Private Sources.
				Served from Public Source.	Dependent on Private Sources.	
1.	2.	3.	4.	5.	6.	7.
East Ward -	183,011	13,560	12,770	1,600	11,170	—
Kendal - -	181,912	20,348	20,500	1,150	19,350	—
West Ward -	121,940	8,225	8,318	332	7,986	—
Total -	486,863	42,133	41,588	3,082	38,506	—

B.—Public Water Supplies and Lead Poisoning.

In Tables V.c.* to VII.c. will be found an analysis of the circumstances as regards source, delivery, and distribution of the public water supplies in the county of Westmorland; together with information as to the presence or absence of lead poisoning in connexion with such supplies.

From these tables it will be seen that no led poisoning attributable to public water supply has been reported as regards this county. Three cases only of any kind are mentioned; one some years ago at Kirkby Lonsdale, the patient being a painter; one more recently, a plumber at Kendal; and one recent case in the Windermere Urban District, apparently due to drinking water from a private well, the pump in connexion with which had been newly constructed. The water from this pump, the Medical Officer of Health ascertained, contained an appreciable quantity of lead.

As in the case of Cumberland, so in Westmorland, lead service pipes and lead cisterns are but little used.

* There being no county boroughs in Westmorland there is no material for Table IV.c.

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TABLE V C.

NOTES with reference to WATER COMPANIES in the County of Westmorland otherwise Treated in the Water Authority and Combined Sanitary Districts Area as to considerations of interest to Consumers of the Water

Name of Water Company.	Districts supplied	Estimated Population supplied by the Water	Source of the Water
1	2	3	4
Ambleside Gas and Water Company	Ambleside, U.S.D.	[illegible]	Scandale Waters (3 miles distant)
Kendal Union Gas and Water Company	Kendal, U.S.D. Kendal, R.S.D. (part)	14,000 580 14,580	Partly from reservoir at Bleaze Knott (4½ miles from Kendal) and partly from deep well at Mint Bank
Windermere District Gas and Water Companies	Windermere, U.S.D. Grasmere, U.S.D.	1,500 2,000 3,500	Dale Valley (4½ miles from Windermere)

TABLE VI C.

NOTING the Water Supplies possessed by URBAN SANITARY DISTRICTS in the or not the Water is Filtered [illegible] Transferring the Water Authority, together with Data [illegible] Sanitary Area as to Circumstances of of Lead Poisoning in [illegible]

Name of Urban Sanitary District Water Supply.	Districts supplied	Estimated Population supplied by the Water	Source of the Water
1	2	3	4
Appleby Corporation Waterworks	Appleby, U.S.D.	[illegible]	Bandarsfell, 2 miles distant
	Brough Sanitary Area, East Ward, R.S.D.	Not known	
Grasmere Local Board Waterworks	Grasmere, U.S.D.	[illegible]	[illegible]
Kirkby Lonsdale Local Board Waterworks	Kirkby Lonsdale, U.S.D.	[illegible]	[illegible]

[Westmorland.]

the Source of Sources of each Supply, whether or not the Water is Filtered or in each instance obtaining the Supply; together with Data for each Sanitary and Facts as to occurrence or not of Lead Poisoning in connexion therewith,

Whether Filtered or otherwise Treated.	Whether Lead Service Pipes are used.	Whether Lead Cisterns are used.	Presence or absence of Lead Poisoning among Consumers of the Water according to Information received from the Medical Officers of Health to the Districts supplied.
5.	6.	7.	8.
No - - -	No	Not for drinking purposes.	None heard of.
Passed through iron screens.	No	No	None heard of.
	,, No	Nearly all iron	None heard of.
No - -	Yes	No	None heard of as due to public water supply.
	No	Very few	None heard of.

[Westmorland.]

County of Westmorland, the Source or Sources of each such Supply, whether and the several Sanitary Districts in each instance obtaining the Supply; delivery to Consumers of the Water, and Facts as to the occurrence or not

Whether Filtered or otherwise Treated.	Whether Lead Service Pipes are used.	Whether Lead Cisterns are used.	Presence or absence of Lead Poisoning among Consumers of the Water according to the Information supplied by the Medical Officers of Health.
5.	6.	7.	8.
No -	No	No	None heard of.
- - -	Not stated	Not stated	None heard of.
No - -	No	No	None heard of.
No - -	Yes	A few	None heard of as due to the water supply.

TABLE VII.c.

NOTING the Water Supplies possessed by, or provided for, RURAL SANITARY such Supply, whether or not the Waters are Filtered before delivery, and together with Data for each such Place or Locality as to circumstances of Lead Poisoning in connexion therewith.

Name of Rural Sanitary District Water Supply.	Districts supplied.	Estimated Population receiving the Water.	Source of Water.
1	2	3	4
East Ward, R.S.D.:			
a. Dufton supply.	Dufton - - -	300	All from springs -
b. Whiston supply.	Whiston - -	150	
c. Hilton supply.	Hilton - - -	150	
d. Orton supply.	Orton - - -	500	
e. Tebay supply.	Tebay - - -	500	
		1,600	
Kendal, R.S.D.:			
a. Braithwaite Green supply.	Braithwaite Green -	200	Not stated - -
b. Natland supply.	Natland - - -	100	Spring - - -
c. Gatebeck supply.	Gatebeck - - -	200	Reservoir fed by brook
d. Staveley supply.	Staveley - - -	100	Spring - - -
		600*	
West Ward, R.S.D.: Askham water supply.	Askham Village -	332	Spring on Askham High Field allotment.

* It is estimated that other 550 persons in the Kendal R.S.D. obtain water 150 from the Kendal Union Gas and Water Company. The former are shown total population given in column 3 of Tables V.c., VI.c., and VII.c. is therefore 400 served from public sources in Westmorland being thus 27,324 and not 26,924, as

[Westmorland.]

Districts in the County of Westmorland, the Source or Sources of each the Townships, Localities, or Places in each instance obtaining the Supply; of delivery to Consumers of the Water, and Facts as to the occurrence or not

Whether Filtered or otherwise treated.	Whether Lead Service Pipes are used.	Whether Lead Cisterns are used.	Presence or absence of Lead Poisoning among Consumers according to the Information supplied by the Medical Officers of Health.
5.	6.	7.	8.
c. Filtered through gravel. *d.* and *e.* Stored in iron tanks.	-	-	None heard of in connexion with any of these supplies.
Not treated in any way.	No	A few; but nearly all iron.	None heard of.
Not stated -	No	-	None heard of.

from public sources, viz., 400 from the Grange Local Board Waterworks and in Table VI. A. [Lancashire], and the latter in Table V.C. [Westmorland]. The short of that given in column 5 of Tables II.C. and III.C.; the estimated population would appear from Tables V.C., VI.C., and VII.C.

ADDENDUM D.

DESCRIPTION of the METHODS adopted in INVESTIGATION of WATER SAMPLES.

A. Chemical Examination.

The chemical examination of the selected waters comprised determination of:—

(*a.*) *Appearance in 2-foot tube.*—The experiments with the 2-foot tube were carried out in the usual way, and the observations as to colour, turbidity, and residue, afforded a rough indication of the quality of the water as regards the presence of suspended and dissolved vegetable matter.

(*b.*) *Reaction with alcoholic solutions of Cochineal, Methyl Orange, and Lacmoid.*—These qualitative observations of the reaction of the waters with different and delicate indicators were regarded as important; the reaction of soft moorland waters being not fully understood, there was a presumption in favour of one indicator succeeding where another failed, in demonstrating the presence of acidity, or, it might be, of alkalinity.

(*c.*) *Residue on Evaporation.*—The estimation of the total solids was carried out in the usual manner; and it was considered not unimportant to discover the loss on ignition, as bearing on the different behaviour of vegetable organic matter, and mineral matter, when subjected to heat.

(*d.*) *Ammonia* (*free and albuminoid*).—The ammonia was estimated by Wanklyn's process. Of each sample an amount was distilled sufficient to allow of four lots (each of 50 c.c.) being successively collected and separately Nesslerised *before*, and of other four lots (each of 50 c.c.) being similarly dealt with *after*, the addition of the alkaline permanganate solution. The reason was that experience showed that in many cases, where moorland water was in question, the ammonia was only slowly given off, so that the last 50 c.c. collected contained an appreciable quantity of ammonia. A considerable number of experiments were also carried out to determine the amount of suspended ammonia in the several waters examined.

(*e.*) *Oxidized Nitrogen.*—The nitrites were determined qualitatively by Griess's napthylamine process; and the nitrates quantitatively by the copper-zinc couple process.

The determination of the nitrates, and the presence or absence of nitrites, was of importance, as it has been held that the action on lead of waters largely depends on the state of combination of nitrogen with oxygen contained in the water.

(*f.*) *Oxygen required to Oxidize the Organic Matter.*—The oxygen required to oxidise the organic matter was determined by the Tidy process as modified by Blair, the water being kept for two hours at a temperature of 100° C. The standard solutions were sodium thiosulphate and potassium permanganate.

(*g.*) *Chlorine.*—The chlorine was estimated in the usual way, with a standard solution of silver nitrate, and a solution of potassium chromate as indicator.

(*h.*) *Hardness.*—Clarke's soap test was used to determine the hardness.

The importance of keeping a record of the hardness of the waters needs no comment, since many investigators assert that it is especially soft waters which act on lead; that hard waters hardly ever possess this ability.

(*i.*) *Dissolved Oxygen.*—Thresh's process was used to estimate the amount of the dissolved oxygen. The precaution was taken of always having the samples bottles filled completely full of water and of using—as soon after the collection as possible—the first portion of water taken from the bottle for analysis, for the determination of the dissolved oxygen.

(*j.*) *Iron.*—The presence of iron was always tested for, as a suspicion existed that iron might, in some way or other, be a factor in giving a water plumbo-solvent ability.

(*k.*) *Acidity.*—Whenever a water was found to give an acid re-action with methyl orange, cochineal, or lacmoid, the amount of the acidity was determined by titrating a known quantity of the water with a decinormal solution of sodic carbonate. Phenol-phthalein was used as an indicator, and although open to some objections, it was found that by its use comparable results were obtained. The acidity was estimated quantitatively, with the object of seeing whether the plumbo-solvent ability of a particular water, from time to time, or of one water as compared with another water, varied directly with the amount of the acidity.

(*l.*) *Plumbo-solvency.*—A determination of the plumbo-solvent properties of the various waters was considered essential; but the difficulty arose that of all the methods in use, when this inquiry commenced, none gave comparable results. To Dr. Whitelegge is due the credit of suggesting the filtration of the water through lead shot. It was found, however, that ordinary lead shot did not react very sensibly to the influence of acid waters; shot, therefore, was specially prepared, free from arsenic and the other impurities which give to ordinary lead shot its necessary quality of hardness.

The process was carried out in the following way:—

Fifty c.c. of washed lead shot were placed in a burette, occupying 18 inches of its length, and the sample water allowed to filter slowly downwards through the lead. The water was collected in successive lots of 50 c.c., and tested with sulphuretted hydrogen or ammonium sulphide for the presence of lead. The amount of lead was estimated by colour-titration, the standard solution of lead acetate being of such a strength that 1 c.c. was equivalent to 1 mgrm. of lead.

The experiments were carried out in a comparative manner, and the precaution was taken of using fresh shot for each determination, the old shot being thrown aside lest its use should introduce a possible source of error. A note was taken of the temperature of the water during the course of the experiment.

B. *Bacteriological examination of the selected Waters.*

The bacteriological examination of the selected waters comprised:—

(*a.*) The estimation of the number of bacteria.

(*b.*) The separation, and study of pure culture, of the different kinds of micro-organisms.

The bacteriological examination was conducted as follows:—

The samples of water were collected in sterilised tubes, and submitted to examination the same day, as soon after collection as possible.

The numerical determination of the bacteria was made by inoculating nutrient gelatin with a suitable quantity of the water, and pouring the melted gelatin into Petri-dishes. In the earlier experiments Agar-Agar, as well as gelatin, was used as a nutritive medium. The cultivations were kept at a temperature of 20° C. and 37° C., according to whether the medium was gelatin or Agar. The colonies were counted at as late a date as the liquefaction of the gelatin and the crowding of the organisms would allow. Pure cultivations were made of the different kinds of microbes met with in the investigation, with the object of discovering points of distinction between the different waters, not only as regards the number but also as to the characteristics of the bacteria contained in them.

It was thought that the bacteriological study of these waters undertaken side by side with the chemical experiments, and more especially with the comparative experiments on plumbo-solvency, might perhaps establish a relation between the ability of a water to act on lead, and the number or the species of its contained bacteria.

App. A. No. 18.

On the Causes of Lead Poisoning; by Mr. Power.

ADDENDUM H

Description of two Bacteria isolated from Peat, which when grown in peat decoction gave to the liquid acid reaction and partial solventability, by Dr. A. C. Houston.

These two micro-organisms are provisionally termed Peat Bacterium O, and Peat Bacterium Q. It is not intended in this paper to give a full account of these two bacteria: their description will be undertaken in a detailed report. An outline only of their biological and morphological characteristics is here attempted.

Description, in tabular form, of two Bacteria Isolated from Peat Soil, which would appear to be causally related to the observed acidity of moist peat soil on moorland gathering grounds.

Peat Bacterium O.	Peat Bacterium Q.
(A.) Where found.	
Found in peat soil—rarely in peat water.	
(B.) How isolated.	
Isolated directly from peat soil by gelatin plate cultivation; and also, indirectly, by inoculating sterile peat decoction with an exceedingly small amount of peat soil, and, in the cases where acidity was produced, making plate cultivations from the liquid.	
(C.) Morphological characters.	
The cells, which are irregularly grouped together, appear at first like cocci; but careful observation shows that in reality one diameter slightly exceeds the other. The cells are non-motile.	
(E.) Biological characters.	
There is no liquefaction of the gelatin.	
(G.) Growth in gelatin plate, and "roll" cultivations.	
(1.) Microscopic appearances.—The chief points to be noted in studying the growth of the superficial colonies are:—	
The reduced amount of transparency, and the character of the young colonies.	This bacterium resembles O very closely, but the colonies do not grow or spread so quickly and are more transparent. The ultimate size of the colonies is less, and the thickening of the bacterial mass as growth proceeds is greater and more marked.
The regular manner in which the colonies spread over the nutrient surface, and the regular thickening of the bacterial mass.	
The characteristic appearance of the colonies as viewed on plates, each labelled, dated, and named by date, and the granular structure characteristic of these colonies.	
The deep colonies occur as small white bodies more or less circular in shape, which either remain suspended in the gelatin plate, or, by reaching the surface in their growth, extend out superficially as greyish or white patches.	Practically the same as O.

Peat Bacterium O.	Peat Bacterium Q.
(2.) Microscopic appearances (under a low power). The superficial colonies are greyish brown in colour. The remains of the original colony can usually be seen near the centre as a dark spot, and from this the colour fades towards the periphery; the edge in the older colonies, however, is dark owing to its greater thickness. The colonies have a granular and striated appearance. The deep colonies show no special peculiarities; they are dark brown in colour and faintly granular in structure.	The colonies are more opaque, and their colour darker, otherwise the appearances are the same as in O.
(*b.*) Growth in gelatin puncture cultivations.	
A white coloured growth appears along the line of the inoculation, composed of numberless small colonies which have become confluent—the puncture has thus a granular appearance. The marked development of gas which occurs gives rise to the formation of gas spaces and fissures throughout the substance of the nutritive medium. The growth on the surface is comparable to the growth of the superficial colonies in plate cultivations. At first a thin bluish white iridiscent film forms at the point of inoculation. Later the colony becomes opaque and granular in character, and the border, when it has ceased to spread, becomes irregularly thickened and raised. In old cultivations furrows and radial thickenings run in tortuous lines over the surface of the growth.	The appearances are nearly the same as in the case of O, but the surface growth is more limited in extent, and of greater thickness.
(*c.*) Growth in gelatin stroke cultivations.	
The growth resembles an elongated superficial colony from a plate culture. It begins first as a bluish white film spreading in an irregular fashion on either side of the inoculation stroke. Later the surface of the growth becomes opaque and granular, and the border irregularly thickened.	The appearances are nearly the same as in the case of O, but the growth spreads less in a lateral direction, and is thicker, especially along the edges.

(*d.*) Growth in bouillon cultivations.

The liquid becomes cloudy, but there is no pellicle formation. Gradually a white bacterial deposit collects at the bottom of the tube. The liquid acquires an acid reaction.

(*e.*) Growth in peat decoction.

(The peat decoction was prepared by boiling peat with distilled water, straining through muslin, boiling with peat charcoal, and filtering very slowly through filter paper. The filtration was repeated until the liquid came through perfectly transparent, but of a bright yellow or brown colour.)

The peat decoction became cloudy in appearance, and acquired a distinct acid reaction, as well as considerable plumbo-solvent ability. Control experiments were simultaneously carried out. The action on lead was tested by upward filtration through lead shot.

Moorland waters are known to be acid in reaction, and to have plumbo-solvent properties. These waters are derived, for the most part, from the rain falling on peaty gathering grounds. Part of the rainfall sinks through the soil and comes to the surface again as spring water;

but the greater portion saturates the peat, and escapes only by being washed out of its substance by successive rainfalls and after more or less prolonged contact with the soil. Moist peat is itself acid in reaction; these two bacteria are found in peat, and when grown in peat decoction give rise to acidity and plumbo-solvent ability of the liquid. The inference is, that the acidity and plumbo-solvent ability observed in moorland waters is possibly to be traced to the washing out of the products of the life processes of these bacteria from the substance of peat soil. It is to be noted that the [illegible] the development of these bacteria. Their presence in water is probably accidental, and not causally related to the acidity of the water. For it is unlikely that these micro-organisms would find sufficient nourishment in water for the exercise of their acid-producing function. It must not be assumed from what has been said, that the acidity of peat soil is of necessity due and wholly due to the life history of these or other germs. The [illegible] a complex one, but it is probable that chemical as well as bacterio[illegible] changes are concerned in the production of the acidity. However this may be, it is important to again note that (*a*) moorland waters derived from peat are acid in reaction and have plumbo-solvent abilities; (*b*) moist peat is acid; (*c*) these bacteria are found in peat and when grown in peat decoction give rise to acidity and plumbo-solvent ability of the liquid.

Addendum E.

Diagram showing, as regards Burnmoor Pool Water, certain observed variations, with reference to the Mean in each instance, of Conditions appertaining to it, over the Period April 1892 to March 1893.

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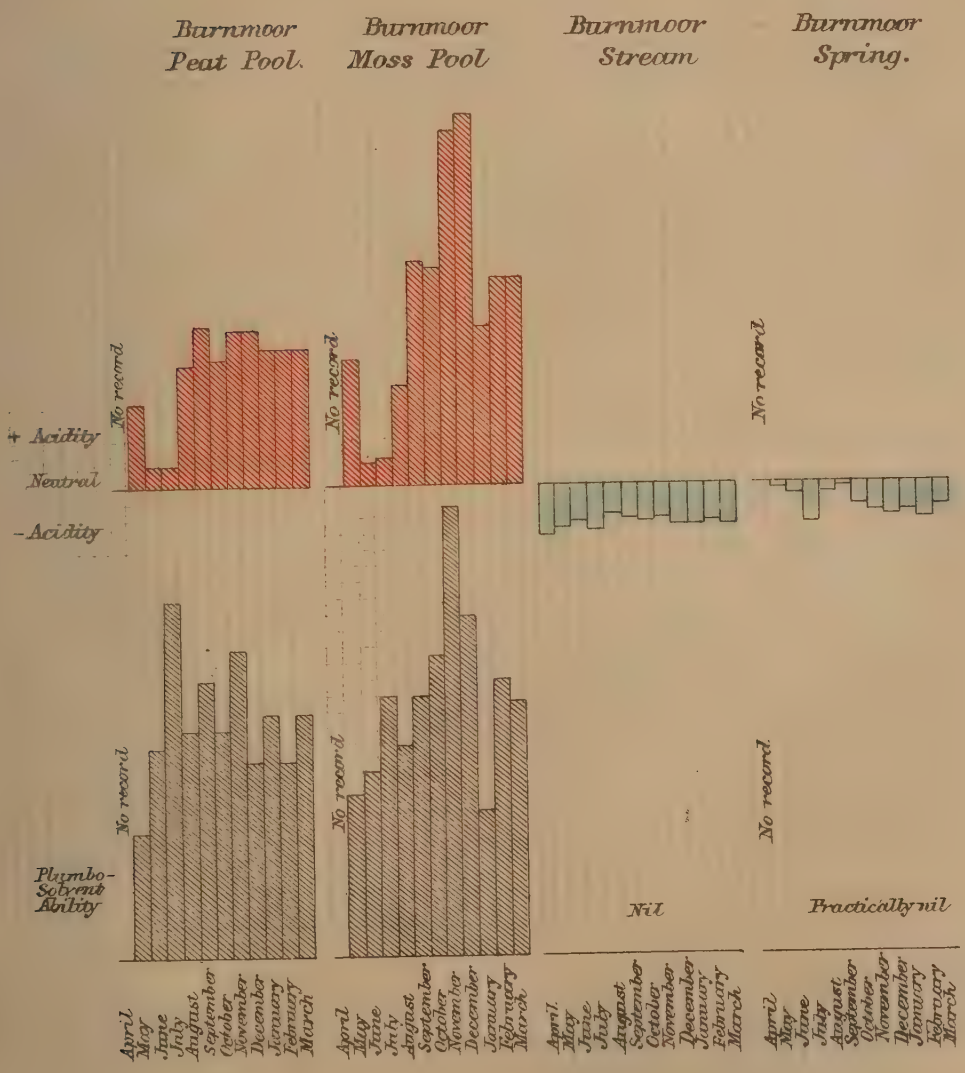
ADDENDUM F.

DIAGRAM SHOWING FOR EACH OF CERTAIN BURNMOOR WATERS THE RELATIONS OF ACIDITY AND PLUMBO-SOLVENCY, MONTH BY MONTH FROM APRIL 1892 TO MARCH 1893.

(The amounts of acidity and Plumbo-solvency refer in each instance to a uniform and arbitrary Scale.)



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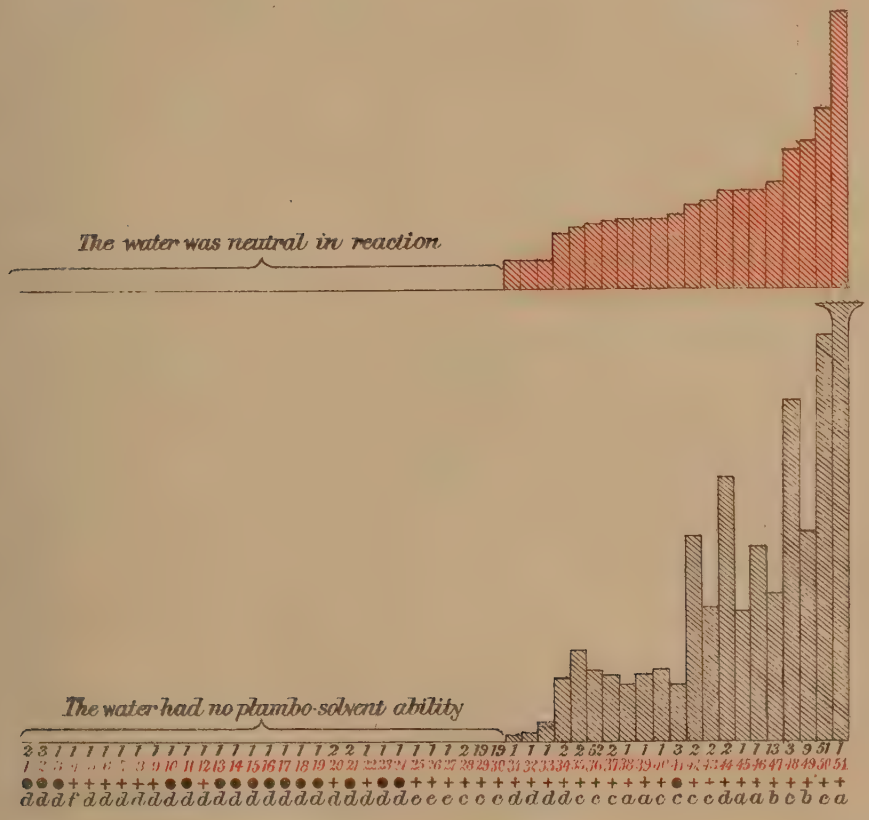
Addendum G.

Diagram showing the relation of the "reaction" of moorland waters to the plumbo-solvent ability. The height of the column in each case shows the average acidity and plumbo-solvent ability for the different waters examined. [Acidity, (red columns) - arranged according to its amount, & action on lead (black columns) in the corresponding samples of water.] The scale is arbitrary in each instance.



The figures in black refer to the number of samples of each water examined.
" " " red " " " " in register by which the water is designated.
a - *water of peat feeder to moorland reservoir.*
b - *water from stagnant peat pool.*
c - *water from moorland reservoir.*
d - *moorland water as sent into consumption.*
e - *spring water to moorland reservoir.*
f - *mixture of peat and spring water to moorland reservoir.*
\+ - *water not "treated" with a view to correcting its plumbo-solvent ability.*
● - *water "treated" " " " " " " " " "*

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No. 14.

Report on Cholera in Germany during the Winter of 1892-93; by Dr. F. W. Barry.

In continuation of my observation of the Western diffusion of cholera published in the last Annual Report* I have the honour to submit the following account of certain outbreaks of the disease that occurred in Germany during the winter of 1892-93, and which must be regarded as directly connected with the diffusion of 1892.

The epidemic of cholera in the German Empire, which commenced at Hamburg on August 16th, 1892, had up to November 19th of that year attacked upwards of 18,500 persons, and had caused over 9,500 deaths. By the middle of November the disease had become practically extinct in Germany, but in December 1892 and in the earlier months of 1893 the three following outbreaks of cholera were observed:—

(*a.*) One at Hamburg, commencing on December 5th, 1892, and terminating on March 3rd, 1893. In this outbreak 64 cases of cholera were recorded, of which 17 proved fatal, and from this group of cases infection was conveyed to five other places, where it gave rise to 11 attacks, of which three were fatal.

(*b.*) A second at Altona, commencing on December 23rd, 1892, and terminating on February 12th, 1893. In this outbreak 45 cases of cholera were recorded, of which 24 proved fatal; and

(*c.*) A third in the Provincial Lunatic Asylum at Nietleben, on the River Saale, near Halle, commencing on January 14th, 1893, and terminating on February 13th. In this outbreak 122 cases were recorded, of which 52 proved fatal. From Nietleben cholera was conveyed to four other places, situate lower down the River Saale, where it gave rise to 13 attacks, of which four were fatal.

All three outbreaks have been very fully investigated by Professor Koch,†; that at Hamburg also by Drs. Reincke‡ and Gaffky§; and I propose to quote at considerable length from the reports of these gentlemen, as the outbreaks in question were of exceptional interest from an etiological point of view.

(*a.*) *The after-epidemic in Hamburg.*—As already stated, the first case of cholera occurred on December 5th, 1892, and the last on March 3rd, 1893. Including those only slightly affected, and a few who showed no signs of disease except the presence of "commas" in their dejecta, 64 persons were attacked, and of these 17 died. In the following Table I., is given a daily record of the cholera cases and deaths as reported by Dr. Reincke, during the period under consideration, from which it will be seen that considerably more than half the cases occurred during the last fortnight of the year.

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* *See* Supplement to the 22nd Annual Report of the Local Government Bodes 1892-93, pp. 117-236.

† Die Cholera in Deutschland, während des Winters, 1892 bis 1893. Von Professor R. Koch. Zeitschrift für Hygiene und Infectionskrankheiten. Fünfzhnter Band, 1893, pp. 89-165.

‡ Bericht des Medicinal Inspectorats über die Medicinische Statistar d,ke Hamburgischen. Staates für das Jahr, 1892, pp. 44-50.

§ Die Nach-Epidemie im Winter 1892-93. Von Dr. Georg Gaffky. Arbeiten asu dem Kaierlichen Gesundheitsamte. Zehonter Band, pp. 99-115. Berlin, 1894

Table I.

Daily Record of Cholera Cases and Deaths during the Winter of 1892–93 at Hamburg.

Day of Month.	Number of Cholera		Week ending	Number of Cholera		Day of Month.	Number of Cholera		Week ending	Number of Cholera	
	Cases.	Deaths.		Cases.	Deaths.		Cases.	Deaths.		Cases.	Deaths.
1892.			1892.			1893.			1893.		
Dec. 4	—	—				Jan. 8	2	2			
„ 5	1	1				„ 9	1	—			
„ 6	—	—				„ 10	4	—			
„ 7	—	—	Dec. 10	3	2	„ 11	2	1	Jan. 14	9	3
„ 8	2	1				„ 12	—	—			
„ 9	—	—				„ 13	—	—			
„ 10						„ 14	—	—			
„ 11	—	—				„ 15	1	—			
„ 12	1	—				„ 16	1	1			
„ 13	—	—				„ 17	3	—			
„ 14	1	—	„ 17	3	—	„ 18	—	—	„ 21	6	1
„ 15	—					„ 19	1	—			
„ 16	1	—				„ 20	—	—			
„ 17	—					„ 21	—	—			
„ 18	3	1				„ 22	—	—			
„ 19	—	—				„ 23	—	—			
„ 20	2	1				„ 24	—	—			
„ 21	5	1	„ 24	13	5	„ 25	—	—	„ 28	—	—
„ 22	2	1				„ 26	—	—			
„ 23	2	1				„ 27	—	—			
„ 24	4	—				„ 28	—	—			
„ 25	3	1				„ 29	1	1			
„ 26	5	3				„ 30	—	—			
„ 27	3	—				„ 31	—	—			
„ 28	1	—	„ 31	13	6	Feb. 1	—	—	Feb. 4	2	1
„ 29	2	1				„ 2	—	—			
„ 30	3	—				„ 3	1	—			
„ 31	1	—				„ 4	—	—			
1893.			1893.			„ 5	—				
Jan. 1	3	—				„ 6	—	—			
„ 2	—	—				„ 7	—	—			
„ 3	—	—				„ 8	—	—	„ 11	—	—
„ 4	1	—	Jan. 7	4	—	„ 9	—	—			
„ 5						„ 10	—	—			
„ 6	—	—				„ 11					
„ 7	—	—				12–18	—	—	„ 18	—	—
						19–25	—	—	„ 25	—	—

Cholera in Hamburg during the Winter 1892-93.

Plan I.

Day of Month.	Number of Cholera		Week ending	Number of Cholera		Day of Month.	Number of Cholera		Week ending	Number of Cholera	
	Cases.	Deaths.		Cases.	Deaths.		Cases.	Deaths.		Cases.	Deaths.
1893.			1893.			1893.			1893.		
Feb. 26	—	—									
„ 27	—	—									
„ 28	—	—									
Mar. 1	—	—	Mar. 4	1	—						
„ 2	—	—							Total	64	17
„ 3	1	—									
„ 4	—	—									

The topographical distribution of the cases is shown in the annexed Plan, No. I.

In considering the etiology of this outbreak, Professor Koch calls attention to the fact that there are two quite distinct types of cholera outbreaks. One is marked by its explosive nature, a graphic representation of which gives a curve rising suddenly to a considerable height, then falling with almost equal rapidity; the graphic representation of the second type, on the other hand, rising only a little above the base line. Hamburg showed these two types in the summer and winter epidemics of 1892 in an extreme form. The curve of the summer epidemic had the appearance of a very high and sharp triangle with a quite short base, whilst that of the winter epidemic rose so little above the base line that it almost coincided with it. Professor Koch goes on to point out that the first type is produced by the sudden and equable strewing of the infective matter over a place, and that the epidemic which then breaks out takes an explosive course, and its graphic representation forms a curve high and steep in proportion to the quantity of infective matter which has been, so to speak, thrown out. The second type is distinguished from the first, not only by the form of the curve, but also by some other characteristics. The distribution of the cases is not uniform: well-marked centres form in which the disease settles. The cases do not all burst out at once. On the contrary, they follow one another, forming chains, as it were, and a direct connexion can very often be detected between the several cases at one of these centres. A person, for example, who has come from some place outside falls ill. A few days later a member of the family in which the patient was nursed is attacked, and then in rapid succession, but often also at considerable intervals, other members of the family, inhabitants of the same house, neighbours, visitors, and the like. The infection may be carried from the first centre and new centres formed in other parts of the city or in neighbouring places, where new chains of successive cases form larger or smaller groups.

These two types of outbreak are frequently combined, and commonly the first type assumes gradually the character of the second, and merges its identity in it. It also frequently happens that a local epidemic begins as one of the second type, and retains this character till the infective matter accidentally finds its way into some article of general

consumption, such as water, when explosions occur varying according to the nature of the vehicle.

The Hamburg summer epidemic belonged at first exclusively to the first type, but towards its end passed into the second. The Hamburg winter epidemic, on the other hand, maintained almost entirely the second type during its whole duration, and a tendency to form centres characterised it from the first. From a reference to Plan I. it will be observed that one of these centres was situate in Neustadt, a second in Sankt Georg, and a third in Sankt Pauli. The centres in Neustadt and Sankt Georg are regarded by Professor Koch, as having, probably, originated in undetected stragglers of the summer epidemic, and that in Sankt Pauli as having had its origin partly in Altona and partly in Neustadt. He further points out that it was a very characteristic feature of the after-epidemic "that the patients belonged, without "exception, to the lowest stratum of the population. They were people "without work and without homes; drunkards living in common "lodging-houses and spirit shops, itinerant hawkers who sold matches, "sausages, or the like, and whose trade led them, too, into such haunts; "sailors, dock labourers, persons under police arrest, &c. In all the "cases, except eight, relation to persons who had suffered from "cholera and from whom the infection might have been directly or "indirectly caught was proved. * * * A common cause, such as "the influence of the soil, the water, or the like, certainly did not exist "in this epidemic. The water supply was out of the question, for the "district affected did not coincide, as in summer, with the sphere of the "water supply. The soil might have seemed open to suspicion, as the "disease was restricted to certain localities. In this case, however, "the place could not be the decisive factor, but, on the contrary, the "people resident in the place, for the disease always ceased the moment "the patients and the suspected were removed. Had the infecting "agent been inherent in the locality, fresh cases should have occurred— "despite the removal of the infected persons—among those who freely "visited the houses in question. The only remaining explanation is "that the disease was transmitted from person to person, and this "explanation is decidedly supported by the chain-like connexion of "most of the cases."

Although it may be assumed that water did not play the part of a general factor in this after-epidemic, its influence as a propagator of cholera was not entirely absent; for from the investigations made, there is little doubt that it had to do with an outbreak among the crews of two ships that lay in Hamburg harbour, the "Murciano," and the "Gretchen Bohlen." The former of these was moored at the Asia Quay, near a closet which is said to have been used by a workman suffering from cholera. On the 8th January, two of the crew were taken to the hospital, suffering from cholera; the remainder, 24 in number, were also removed for observation purposes, and four slight cases of cholera were confirmed amongst them. The vessel was taken to the Strandhafen whilst she was in course of disinfection, and her frozen closets were there thawed (January 12th), and the contents discharged into the water. The SS. "Gretchen Bohlen" was moored close to the "Murciano," and three days afterwards (January 15th) two cases of cholera broke out on board the former vessel. Upon examination of the rest of the crew, 17 in number, four more slight cases of cholera were confirmed. It was ascertained that these men had, like the men on the "Murciano," drunk much water taken directly from the harbour, at points which must, from the circumstances related above, have been specifically polluted by cholera dejecta.

Although the winter epidemic in Hamburg was, compared with that which occurred in the city in the previous summer, very slight, it was not without its offshoots. In the beginning of January, a man travelled from Hamburg to Schwerin, and died there from cholera. Four cases were carried from Hamburg to Elmshorn in the Pinneberg district. Another case the cause of which was stated not to have been completely cleared up, is said to have occurred near Hamburg, at Ostorf, also in the district of Pinneberg. On January 6th, a ship's carpenter who had worked in that part of Hamburg harbour in which the "Murciano" was moored, died of cholera at Neuhof, on the island of Wilhelmsberg, in the Elbe. Three cases of cholera occurred at Schulau, and one at the adjacent town of Wedel. These cases could not be traced directly to Hamburg, but the water of the Elbe would appear to have formed the connecting link.

The comparatively light fatality observed during the winter epidemic, namely, 26·5 per cent. of the cases attacked, was probably not due to any lessened virulence of the disease, but to the fact that many slight cases—cases in which the presence of cholera bacilli was confirmed, but which presented very slight symptoms, or none, of cholera,—were included amongst the attacks.

(*b.*) *The Winter Epidemic in Altona.*—In Table II. is given a daily record of the cholera cases and deaths reported to have occurred at Altona during the winter of 1892–93, from which it will be seen that the first case took place on December 23rd, at about the time when the winter epidemic in Hamburg was at its height, and that upwards of two-thirds of the total cases were recorded during the three weeks ended February 11th, 1893.

Table II.

Daily Record of Cholera Cases and Deaths during the Winter of 1892–93 at Altona.

Day of Month.	Number of Cholera		Week ending	Number of Cholera		Day of Month.	Number of Cholera		Week ending	Number of Cholera	
	Cases.	Deaths.		Cases.	Deaths.		Cases.	Deaths.		Cases.	Deaths.
1892.			1892.			1893.			1893.		
Dec. 18	—	—				Jan. 1	—	—			
„ 19	—	—				„ 2	—	—			
„ 20	—	—				„ 3	—	—			
„ 21	—	—	Dec. 24	1	—	„ 4	—	—	Jan. 7	2	
„ 22	—	—				„ 5	1	1			
„ 23	1	—				„ 6	—	—			
„ 24	—	—				„ 7	1	—			
„ 25	1	1				„ 8	—	—			
„ 26	—	—				„ 9	—	—			
„ 27	1	1				„ 10	—	—			
„ 28	—	—	„ 31	4	4	„ 11	1	—	„ 14	1	—
„ 29	—	—				„ 12	—	—			
„ 30	2	2				„ 13	—	—			
„ 31	—	—				„ 14	—	—			

Day of Month.	Number of Cholera		Week ending	Number of Cholera		Day of Month.	Number of Cholera		Week ending	Number of Cholera	
	Cases	Deaths		Cases.	Deaths		Cases	Deaths		Cases	Deaths
1893.			1893.			1893.			1893		
Jan. 15	—	—				Feb. 5	1	—			
„ 16	—	—				„ 6	3	—			
„ 17	—	—				„ 7	—	—			
„ 18	—	—	Jan. 21	1	—	„ 8	—	—	Feb. 11	9	2
„ 19	—	—				„ 9	—	—			
„ 20	—	—				„ 10	2	1			
„ 21	1	—				„ 11	3	1			
„ 22	—	—				„ 12	1	—			
„ 23	1	1				„ 13	—	—			
„ 24	1	1				„ 14	—	—			
„ 25	2	2	„ 28	8	6	„ 15	—	—	„ 18	1	—
„ 26	1	—				„ 16	—	—			
„ 27	2	2				„ 17	—	—			
„ 28	1	—				„ 18	—	—			
„ 29	1	1									
„ 30	2	1									
„ 31	2	2									
Feb. 1	1	—	Feb. 4	18	11						
„ 2	3	1							Total	42	24
„ 3	8	5									
„ 4	1	1									

This winter epidemic in Altona bore an entirely different character from that which prevailed in the summer. In the summer of 1892, the great majority of the patients were connected with Hamburg, and in all probability had caught the infection on Hamburg soil, or from persons who had brought it thence. Now, on the contrary, according to Professor Koch, "the patients were, with few exceptions, persons whose "illness could not possibly be explained in that way. They were, "for instance, workmen in fairly good circumstances, whose work did "not require them to go to Hamburg; women of the middle class, "little children who, owing to the cold weather, had not even been out "of the house, a one-year's service soldier, inmates of the hospital "who had been confined to bed for weeks, and had not come into "contact with anybody outside; and a prisoner who fell ill after 12 "days' solitary confinement. There was no connexion whatever "between any of these cases. The simultaneous epidemic in Hamburg "was restricted without exception to the lowest stratum of the popula- "tion, whereas in Altona, only one of the patients, a homeless woman, "belonged to the lowest class, all the rest were persons who could not "have caught the disease by immediate transmission from uncleanly

" people crowded together in unhealthy rooms. Evidently the cholera " in Altona was of a quite different type from that in Hamburg, and " the only explanation of the phenomena was that the infectious matter " was scattered all over the town, but only scantily."

The water supply was at once suspected, for it was clear from the position of the Altona waterworks, situate as they are below Hamburg, that any accident to the filtration works might lead to the distribution of cholera-infected matter by the water service. That disturbances in the working of the Altona filters did actually occur immediately before the outbreak, and that the presence of cholera bacilli was demonstrated in the Elbe water and in the water of the Altona waterworks before filtration, has been fully set forth in Professor Koch's paper on "Water Filtration and Cholera," published in the Medical Officer's last Report.*

Although there is little doubt that the dissemination of cholera in Altona was primarily caused by the distribution of infective matter through the water service, in several instances the infection was at a later date conveyed through other channels. In two or three groups of cases it was transmitted from one member of a family to another, whilst one secondary group of cases is of special interest, and must be referred to in some detail. An account of this outbreak may be summarised from Professor Koch's Report already referred to.

In the Ottensen quarter of Altona there is a small group of houses arranged in courts, which were erected after the great Hamburg fire of 1842 in order to provide shelter for the burned-out people as soon as possible. These courts, which bear the name of "Lang Jammer," are inhabited by about 270 poor people. The houses are not connected with the public water-supply, but obtain their water from an old pump well, situate near the entrance to one of the courts. During the summer epidemic of 1892, two isolated cases only of cholera had occurred in the "Lang Jammer:" so that when, in one week of the winter outbreak, nine attacks with seven deaths took place there, whilst the neighbourhood remained free, attention was at once directed to the special circumstances of the place, with a view to ascertaining the reason of this exceptional cholera incidence. As already stated, the water supply was obtained from a well. This well was so placed at the lowest part of the court in which it was situate that all liquid on the surface of the court had a natural flow towards it. Under ordinary circumstances, the fouling of the well was provided against by drains leading from gulleys to a sewer in the street. The water of this well had been examined early in 1892, and was then found to be fit for use. As, however, this water was suspected of having been the cause of the diffusion of cholera in the winter outbreak, a bacteriological examination of it was made on January 31st, 1893, with the result that the presence in the water of large quantities of Koch's comma-bacillus was demonstrated. The outbreak of cholera in the "Lang Jammer" began on January 20th and ended on February 1st, so that if the water had played a part in the diffusion, it must have become infected some days before January 20th, and on further inquiry, it was ascertained that from December 21st, 1892, to January 24th, 1893, there had been a hard frost, and that during that period the gulleys were frozen up, and slops and other filth passed unchecked to the well. Here it was ascertained that liquid filth obtained access to the water through chinks in the wall of the well. After the well was closed no further cases of

* Supplement to the 22nd Annual Report of the Local Government Board, 1892–93, Appendix C., pp. 448–455.

cholera occurred in that quarter. It may be noted that after disinfecting the yard, on the occurrence of the first cholera case, the water drawn from the well smelt of carbolic acid. How the cholera found its way in the first instance into the "Lang Jammer" was not discovered. The last cholera case in Altona was observed on February 12th; the total cases recorded being 45 with 24 deaths, equivalent to a fatality of 53·3 per cent.

(c.) *Cholera at Nietleben.*—The lunatic asylum at Nietleben, near Halle, was the seat of a peculiarly interesting outbreak of cholera, in January 1893, which was regarded as an offshoot of the Hamburg after-epidemic. The asylum, which was built in 1840, consists, as will be seen from Plan II., of a number of detached pavilions. On January 14th, 1893, the asylum contained 436 male patients, 375 female patients, 124 officials who had, and 56 who had not, their meals in the establishment, altogether, a population of 991 persons. On January 14th, a patient living in that part of the building marked "A" in the Plan, was attacked with cholera, and died the same day. On the next day (January 15th) six cases, all of which were fatal, occurred. On the 16th, there were eleven further cases, eight of which were fatal. These eighteen cases occurred in eleven different wards, in ten different buildings of the asylum. From this time onwards, further cases were reported until February 13th, by which time there had been 122 cases and 52 deaths. The sequence in point of time, of these cases is shown in the following Table III. :—

TABLE III.

DAILY RECORD of CHOLERA CASES and DEATHS at the NIETLEBEN LUNATIC ASYLUM during January and February, 1893.

Date	Recorded Cholera		Date	Recorded Cholera.	
	Attacks.	Deaths.		Attacks.	Deaths.
1893.			1893		
January 14 - -	1	1	January 25 -	5	4
„ 15 - -	6	6	„ 26 -	3	1
„ 16 - -	11	8	„ 28 -	2	1
„ 17 - -	15	7	„ 31 -	1	1
„ 18 - -	8	2	February 1 -	1	—
„ 19 - -	2	2	„ 4 -	1	1
„ 20 - -	16	6	„ 8 -	1	1
„ 21 - -	9	3	„ 10 -	1	1
„ 22 - -	12	5	„ 13 -	1	—
„ 23 - -	8	1			
„ 24 - -	13	1	Total -	122	52

Of the 122 cholera patients, 63 were men, including three doctors, and 59 were women, including seven attendants and three wives of officials. In order to give an exact view of the local distribution of the disease, the following Table IV., taken from Professor Koch's report on the outbreak is appended. In this table are given the various departments of the asylum, the number of beds in each department, the number of inmates on the day when cholera broke out, and the cases with the dates of their occurrence.

Table IV.

Showing, as regards the several Departments of the Nietleben Lunatic Asylum, the Number of Beds, the Number of Inmates, on January 14th, 1893, and the Number of Persons attacked by Cholera in each Department with the Date of Attack in each Case.

(a.) *The Men's Side.*

Department.	Number of Beds.	Number of Inmates on 14th January 1893, including the Attendants.	Cholera Cases recorded.	Remarks.
Pavilion for curable male patients, lower storey (A I.).	30	28	2 (Jan. 14, 24).	
Pavilion for curable male patients, upper storey (A II.).	9	8	- - - -	Seven patients of the first and the second class with one attendant.
Pavilion for curable male patients, lower storey (B I.).	34	34	4 (Jan. 23, 24, 24, 24).	
Pavilion for curable male patients, upper storey (B. II.).	34	33	4 (Jan. 16, 20, 23, 25).	
Pavilion for incurable male patients, lower storey (C I.).	20	18	4 (Jan. 16, 20, 23, Feb. 10).	Sixteen patients of the first and the second class with two attendants.
Pavilion for incurable male patients, upper storey (C II.).	51	48	5 (Jan. 19, 19, 22, 22, 23).	
Pavilion for incurable male patients, lower storey (D I.)	54	52	5 (Jan. 20, 20, 22, 22, 23).	
Pavilion for incurable male patients, upper storey (D II.).	46	45	7 (Jan. 17, 17, 20, 20, 20, 21, 22).	
Male Observation Wards (E) -	30	29	2 (Jan. 18, Feb. 4).	
Men's Pavilion (F) - -	33	32	7 (Jan. 15, 16, 17, 17, 17, 17, 20).	
Men's Hospital (G) - -	36	23	2 (Jan. 22, 22).	
Male Receiving Wards (R) -	33	32	7 (Jan. 15, 15, 15, 16, 18, 18, 24).	
Men's Pavilion (S) - -	44	37	5 (Jan. 15, 16, 16, 20, 20).	
Men's Pavilion (T) - -	44	36	4 (Jan. 18, 24, 24, 26).	
Men's Pavilion (U) - -	44	—	1 (Jan. 21) a female attendant).	Used immediately after the outbreak of the cholera as a cholera hospital. The patients in (V) were removed to other departments.
Men's Pavilion (V) - -	44	36	1 (Jan. 26) an incurable patient employed in the disinfecting house.	
Men's Pavilion (W) - -	44	—	3 (Jan. 22, Feb. 1, 13) three female attendants.	

App. A. No. 14.

(b.) *The Women's Side.*

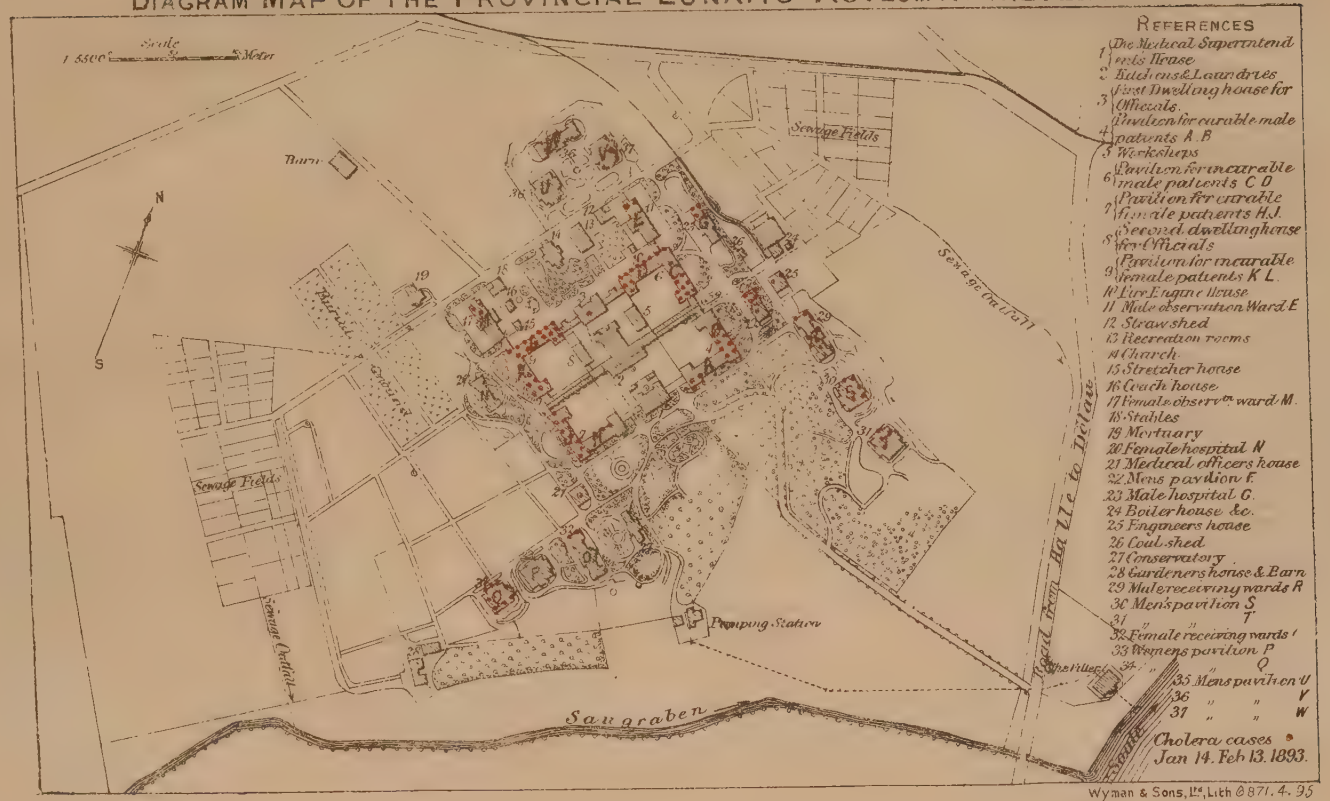
Department.	Number of Beds.	Number of Patients in the Department on January 31st, and during the Quarter.	Cholera Cases recorded.	Remarks.
Pavilion for curable female patients, lower storey (H I.)	34	31	6 (Jan. 17, 22, 22, 25, 23, 24).	[illegible]
Pavilion for curable female patients, upper storey (H II.)	12	9	- - -	[illegible]
Pavilion for curable female patients, lower storey (J I.).	32	31	3 (Jan. 20, 20, 21).	
Pavilion for curable female patients, upper storey (J II.).	39	38	6 (Jan. 15, 16, 17, 17, 19, 25).	
Pavilion for incurable female patients, lower storey (K I.).	43	40	4 (Jan. 17, 18, 19, 23).	
Pavilion for incurable female patients, upper storey (K II.).	28	28	1 (Jan. 26) - -	Twenty-four patients of the first and second class with four attendants.
Pavilion for incurable female patients, lower storey (L I.).	47	46	12 (Jan. 19, 20, 21, 21, [illegible]	
Pavilion for incurable female patients, upper storey (L II.)	42	41	5 (Jan. 16, 17, 18, 24, [illegible]	[illegible]
Female Observation Ward (M)	33	33	3 (Jan. 16, 19, 20).	
Women's Hospital (N) -	34	35	2 (Jan. 17, 21).	
Female Receiving Ward (O) -	33	34	2 (Jan. 18, 23).	
Women's Pavilion (P) - -	44	23	—	
Women's Pavilion (Q) - -	41	42	8 (Jan. 16, 16, 16, 18, 19, 20, 24).	The [illegible] the ward was [illegible]

(c.) *The Officials' Houses.*

Department.	Cholera Cases.	Remarks.
[illegible] -	2 (Jan. 17, 17) - - -	Wards [illegible]
[illegible] -	3 (Jan. 21, 24, 28) - -	Two [illegible]
[illegible] -	1 (Jan. 2[illegible]	A [illegible]

From the Table IV. and from Plan II. it will be seen that the cholera was fairly equally distributed over the establishment, not only at first, but also during the further course of the epidemic. The cause of cholera must therefore have acted, not on certain buildings, or certain groups of the [illegible], but on the whole establishment. In the case in question, only the soil, the privy-tubs, or the water, could have exercised such a common influence. On local investigation, the two first, the soil and

DIAGRAM MAP OF THE PROVINCIAL LUNATIC ASYLUM AT NIETLEBEN. Plan II.



REFERENCES

1. Dir. Medical Superintendents House
2. Kitchens & Laundries
3. First Dwelling house for Officials.
4. Pavilion for curable male patients A. B
5. Workshops
6. Pavilion for incurable male patients C D
7. Pavilion for curable female patients H. J.
8. Second dwelling house for Officials
9. Pavilion for incurable female patients K L.
10. Fire Engine House
11. Male observation Ward E
12. Straw shed
13. Recreation rooms
14. Church
15. Stretcher house
16. Coach house
17. Female observation ward M.
18. Stables
19. Mortuary
20. Female hospital N
21. Medical officers house
22. Mens pavilion F.
23. Male hospital G.
24. Boiler house &c.
25. Engineers house
26. Coal shed
27. Conservatory
28. Gardeners house & Barn
29. Male receiving wards R
30. Mens pavilion S
31. " " T
32. Female receiving wards I
33. Womens pavilion P
34. " " Q
35. Mens pavilion U
36. " " V
37. " " W

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the provisions, were set aside. The construction and the management of the water system, which receives its supply from the Wild Saale, is fully described in Professor Koch's paper on "Water Filtration and Cholera," published in the Supplement to the last Annual Report of the Board. (*See* Appendix C., pp. 444–448.) Its main course is indicated in Plan II.

"Close to the Wild Saale lie the filters, from which an underground iron "pipe leads the water to the pumping station at the foot of the hill. It "is thence pumped into high reservoirs in buildings 2 and 3, whence it "is distributed all over the establishment by pipes. Another system of "pipes collects the dirty water from the sinks, waterclosets, bath-rooms, "kitchens, &c., and leads it into two main sewers which begin at building "2 and go in opposite directions to the sewage fields on the slopes of "hill on both sides of the establishment. These sewers are of mason "work, are provided with manholes and are up to date in every "respect. The sewage fields, too, are properly laid out. They consist "of horizontal beds rising one above the other. Their soil is drained "to a sufficient depth. The effluent water is collected in a main "conduit, and led in open ditches, both from the northern and the "southern sewage field into a dirty little brook called the Saugraben."

To the fact that this same brook flows into the Wild Saale at a very short distance above the intake of the asylum waterworks and to the grave objection to such an arrangement of the sewerage and water systems, attention has been called in Professor Koch's paper referred to above. In that paper he pointed out that, as managed, much of the water supplied to the establishment was allowed to pass through the sand filters almost unfiltered. As a consequence of this, it was clear that if infective matter was pumped from the Wild Saale, there would be no difficulty in its distribution throughout the institution. Upon inquiry, it was found that immediately prior to the outbreak of cholera, the sewage fields had been frozen, and the asylum sewage had consequently found its way into the Wild Saale practically untreated. Upon bacteriological examination being made, cholera bacteria were found, on the women's side of the asylum, in the sewage at the point where it entered the sewage fields, in the sewage fields themselves, and in the effluent from the sewage fields. On the men's side they were found in the sewage, both before and after its passage over the sewage fields. They were further found in the water of the Wild Saale, also below the mouth of the Saugraben, in the water immediately after it had passed through the filters, and in a sample taken from one of the water pipes in the asylum itself. Once more to quote Professor Koch:—

> "The immediate cause of the explosive outbreak at Nietleben is "thus rendered perfectly clear. Infectious matter must have been "brought into the asylum in some way or other, then passed with "the dirty water of the establishment over the frozen sewage fields "into the Saugraben, from the Saugraben into the Wild Saale, "and from the Wild Saale through the water conduit back to the "asylum. The water was accessible to all the inhabitants of the "establishment, and an explosive epidemic, attacking the whole "asylum, more or less equally, according to the quantity of specific "infective material in the water, the relations of the inmates to the "water, and their individual predisposition, was inevitable, and "accordingly took place."

Many of the later cases were no doubt due to secondary infection. How cholera was introduced into the asylum in the first instance was not satisfactorily made out, but it was suspected that it was brought by one or other of certain attendants who had come to the asylum shortly before the outbreak. It was ascertained as regards one of these, who

On Cholera in Germany in the winter of 1892-93. by Dr. Barry.

was engaged in December, and who had come from Hamburg, that he had suffered from severe diarrhœa shortly after his arrival.

As soon as cholera bacilla were found in the River Saale, the local authorities not only warned the people living lower down the river against the use of the water for drinking purposes, but positively forbade it. Notwithstanding this, cholera appeared at four places situate on the Saale, and in each instance, the first case was attributed to the use of the river water. The first place in which cholera appeared was Trotha, a village on the right bank of the Saale, about three miles below Nietleben. Three persons, of whom one died, were attacked with cholera on January 24th, a fourth case, due to secondary infection, followed on January 27th. On January 24th, a person living at Wettin, also on the right bank of the Saale, about 15 miles below Nietleben, was attacked with cholera and died. At Cröllwitz, situate on the left bank of the Saale, about two miles below Nietleben, a person was attacked by cholera on January 30th, and this case was followed at intervals by five other cases, two of which died. The last of these outbreaks occurred at Lettin, a village also situate on the left bank of the Saale, about four miles below Nietleben. Here three cases occurred on the 2nd, 3rd, and 4th of February respectively. Of these, one died.

In the foregoing account of cholera in Germany in the winter of 1892–93. I have entered into a certain amount of detail on account of the etiological interest of the outbreaks. As already stated this winter diffusion must be regarded as part of the epidemic of 1892.

No. 15.

Memorandum on the Progress of the Sanitary Survey made in 1893, in Anticipation of Cholera; by Dr. Barry.

A summary of the results of the emergency survey undertaken in anticipation of cholera in the summer and autumn of 1892 of the Port and Riparian sanitary districts of England and Wales has already been published in the supplement to the Board's Report for 1892–93, pages 237–325. Early in 1893 a further complete and systematic Survey of the Ports and Riparian sanitary districts of this country was commenced, and continued throughout the year. This duty was, under my general supervision, entrusted to Mr. T. W. Thompson, Dr. Theodore Thomson, Dr. Copeman, Dr. Bulstrode, and Dr. Reece, of the permanent medical staff. During the year the whole of the 60 Port sanitary districts were inspected in the above sense, and 35 urban and 9 rural Riparian sanitary districts were similarly inspected, as to the exercise of their functions respecting shipping. Lists of these districts will be found in the following Tables I. and II., and their topographical position is indicated in the annexed Map I. The results, in detail, of the inspection of the whole coast line visited in connexion with the Cholera Survey during 1893–94 will appear in a separate volume.

Table I.—Port Sanitary Districts inspected during 1893.

Name of Port Sanitary District.	Inspector.	Name of Port Sanitary District.	Inspector.
1. Barnstaple	Dr. Bulstrode.	32. Littlehampton	Dr. Theodore Thomson.
2. Barry and Cadoxton	Mr. T. W. Thompson.	33. Liverpool	Mr. T. W. Thompson.
3. Beaumaris	Dr. Reece.	34. London	Dr. Theodore Thomson.
4. Blyth (River)	Mr. T. W. Thompson.	35. Lowestoft	Dr. Copeman.
5. Boston	Dr. Copeman.	36. Maldon	Dr. Reece.
6. Bridgwater	Mr. T. W. Thompson.	37. Milford	„ „
7. Bristol	„ „	38. Newhaven	Dr. Theodore Thomson.
8. Cardiff	„ „	39. Newport	Mr. T. W. Thompson.
9. Cardigan	Dr. Reece.	40. New Shoreham	Dr. Theodore Thomson.
10. Carnarvon	„ „	41. Padstow	Dr. Bulstrode.
11. Chepstow	Mr. T. W. Thompson.	42. Penzance	„ „
12. Chester	Dr. Reece.	43. Plymouth	„ „
13. Colchester	„ „	44. Poole	„ „
14. Cowes	Dr. Theodore Thomson.	45. Portsmouth	Dr. Theodore Thomson.
15. Dartmouth and Totnes	Dr. Bulstrode.	46. Preston	Mr. T. W. Thompson.
16. Deal	Dr. Theodore Thomson.	47. Rochester	Dr. Theodore Thomson.
17. Exeter	Dr. Bulstrode.	48. Sandwich	„ „
18 Falmouth and Truro	„ „	49. Scilly (Isles of)	Dr. Bulstrode.
19. Faversham	Dr. Theodore Thomson.	50. Southampton	Dr. Theodore Thomson.
20. Fleetwood	Mr. T. W. Thompson.	51. Sunderland	Mr. T. W. Thompson.
21. Fowey	Dr. Bulstrode.	52. Swansea	Dr. Reece.
22. Gloucester	Mr. T. W. Thompson.	53. Tees (River)	Mr. T. W. Thompson.
23. Grimsby	„ „	54. Teignmouth	Dr. Bulstrode.
24. Hartlepool	„ „	55. Tyne (River)	Mr. T. W. Thompson.
25. Harwich	Dr. Reece.	56. Wells	Dr. Copeman.
26. Hayle	Dr. Bulstrode.	57. Weymouth	Dr. Bulstrode.
27. Hull and Goole	Mr. T. W. Thompson.	58. Wisbech	Dr. Copeman.
28. Ipswich	Dr. Reece.	59. Workington	Mr. T. W. Thompson.
29. Kingsbridge	Dr. Bulstrode.	60. Yarmouth	Dr. Copeman.
30. King's Lynn	Dr. Copeman.		
31. Lancaster	Mr. T. W. Thompson.		

TABLE II.—RIPARIAN SANITARY DISTRICTS inspected during 1893, as to the EXERCISE of their FUNCTIONS respecting SHIPPING.

(*a.*) URBAN DISTRICTS.

Name of Sanitary District.	Inspector.	Name of Sanitary District.	Inspector.
1. Aberystwith	Dr. Reece.	18. Holyhead.	Dr. Reece.
2. Aldeburgh	Dr. Copeman.	19. Kidwelly	" "
3. Amble	Mr. T.W. Thompson.	20. Llanelly	" "
4. Barmouth	Dr. Reece.	21. Lymington	Dr. Copeman.
5. Barrow-in-Furness	Mr. T.W. Thompson.	22. Maryport	Mr. T.W. Thompson.
6. Berwick-upon-Tweed	" "	23. Millom	" "
7. Bournemouth	Dr. Copeman.	24. Minehead	" "
8. Bridlington	Mr. T.W. Thompson.	25. Scarborough	" "
9. Carmarthen	Dr. Reece.	26. Seaham Harbour	" "
10. Christchurch	Dr. Copeman.	27. Skegness	Dr. Copeman.
11. Criccieth	Dr. Reece.	28. Southwold	" "
12. Dover	Dr. Theodore Thomson.	29. Swanage	Dr. Bulstrode.
13. Filey	Mr. T.W. Thompson.	30. Tenby	Dr. Reece.
14. Folkestone	Dr. Theodore Thomson.	31. Torquay	Dr. Copeman.
15. Great Clacton	Dr. Reece.	32. Towyn	Dr. Reece.
16. Holbeach	Dr. Copeman.	33. Walton-on-the Naze	" "
17. Holme Cultram	Mr. T.W. Thompson.	34. Whitby	Mr. T.W. Thompson.
		35. Ynyscynhaiarn	Dr. Reece.

(*b.*) RURAL DISTRICTS.

1. Belford	Mr. T.W. Thompson.	5. Llanelly	Dr. Reece
2. Blean	Dr. Theodore Thomson.	6. Tendring	" "
3. Docking	Dr. Copeman.	7. Walsingham	Dr. Copeman.
4. Lexden and Winstree.	Dr. Reece.	8. Williton	Mr. T.W. Thompson
		9. Woodbridge	Dr. Copeman.

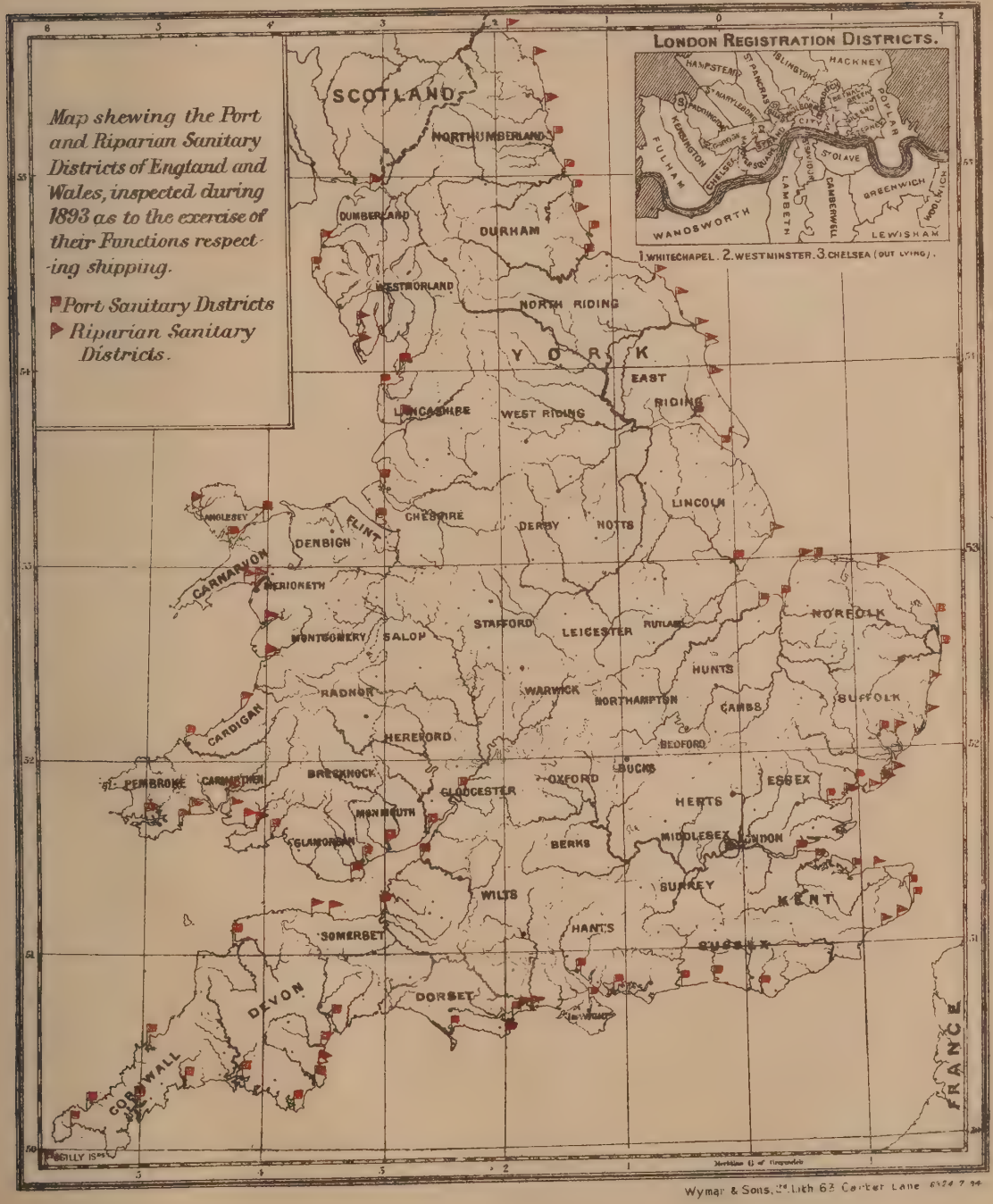
In addition to the inspection [illegible] the districts enumerated in Tables I. and II., 88 urban and 14 rural sanitary districts were visited during 1893 in connexion with the General Cholera Survey. Lists of these districts will be found in Tables III. and IV. respectively, and their position topographically is indicated in the annexed Map II.

In each instance a complete record of the sanitary circumstances and of the sanitary administration of the district visited was obtained on lines similar to those adopted at the Cholera Survey instituted by the Board in 1885. This Cholera Survey work was, under my supervision, carried out by Dr. Bruce Low, Dr. Sweeting, Mr. T. W. Thompson, Dr. Theodore Thomson, Dr. Copeman, Dr. Fletcher, Dr. Bulstrode, and Dr. Reece, of the permanent, and by Mr. E. Evans, Dr. Horne, Dr. Wheaton, and Dr. Wilson, of the temporary staff of the Department.

A summary of the results of these inspections will be published upon the completion of the Survey.

Cholera, Survey of England & Wales 1893.

Map I



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CHOLERA. SURVEY OF ENGLAND & WALES 1893

Map II.

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TABLE III.—URBAN SANITARY DISTRICTS of ENGLAND and WALES inspected during 1893 as regards their SANITARY CIRCUMSTANCES and ADMINISTRATION.

Name of Sanitary District.	Population (Census 1891).	County.	Inspector.
1. Aberystwith -	6,725	Cardigan - -	Dr. Reece.
2. Aldeburgh - -	2,159	Suffolk - - -	Dr. Copeman.
3. Amble - -	2,975	Northumberland -	Mr. T. W. Thompson.
4. Ashbourne - -	3,809	Derbyshire - -	Dr. Wilson.
5. Ashby-de-la-Zouch	4,535	Leicestershire -	Dr. Fletcher.
6. Ashton in-Makerfield.	13,379	Lancashire - -	Dr. Wheaton.
7. Bacup - -	23,498	" - -	" "
8. Barmouth - -	2,045	Merionethshire -	Dr. Reece.
9. Beaconsfield -	1,773	Buckinghamshire -	Dr. Fletcher.
10. Bedlingtonshire -	16,996	Northumberland -	Dr. Wilson.
11. Bedwellty - -	6,773	Monmouthshire -	Mr. E. Evans.
12. Benfieldshire -	6,269	Durham - -	Dr. Wilson.
13. Berwick - upon - Tweed.	13,377	Northumberland -	Mr. T. W. Thompson.
14. Beverley - -	12,539	Yorkshire - -	Dr. Wheaton.
15. Bishop Auckland	10,527	Durham - -	Dr. Sweeting.
16. Blaydon - -	13,371	" - -	Dr. Wilson.
17. Boston - -	14,593	Lincolnshire - -	Dr. Bulstrode.
18. Brandon and Byshottles.	14,239	Durham - -	Dr. Wilson.
19. Burton-upon-Trent	46,047	Staffordshire - -	" "
20. Carmarthen -	10,264	Carmarthenshire -	Dr. Reece.
21. Cleethorpes-with-Thrunscoe.	4,306	Lincolnshire - -	Mr. T. W. Thompson.
22. Consett - -	8,175	Durham - -	Dr. Wilson.
23. Cottingham -	3,880	Yorkshire - -	Dr. Wheaton.
24. Cowpen - -	12,982	Northumberland -	Dr. Wilson.
25. Criccieth - -	1,410	Carnarvon - -	Dr. Reece.
26. Cromer - -	2,197	Norfolk - -	Dr. Copeman.
27. Crowle - -	3,095	Yorkshire - -	Dr. Wheaton.
28. Deal - - -	8,891	Kent - - -	Dr. Theodore Thomson.
29. Exeter - -	37,404	Devonshire - -	Dr. Bulstrode.
30. Felling - -	17,490	Durham - -	Dr. Wilson.
31. Filey - - -	2,481	Yorkshire - -	Mr. T. W. Thompson.
32. Gainsborough -	14,372	Lincolnshire - -	Dr. Fletcher.
33. Godmanchester -	2,095	Huntingdonshire -	Dr. Wheaton.
34. Gravesend - -	23,876	Kent - - -	Dr. Theodore Thomson.
35. Grays Thurrock -	12,219	Essex - - -	Dr. Horne.
36. Great Clacton -	3,584	" - - -	Dr. Reece.
37. Great Driffield -	5,703	Yorkshire - -	Dr. Wheaton.
38. Haverfordwest -	6,179	Pembrokeshire -	Dr. Reece.
39. Hedon - -	979	Yorkshire - -	Dr. Wheaton.
40. Hereford - -	20,267	Herefordshire -	Dr. Bruce Low.
41. Holyhead - -	8,745	Anglesey - -	Dr. Reece.
42. Hoole - - -	3,892	Cheshire - -	Dr. Fletcher.
43. Houghton - le - Spring.	6,476	Durham - -	Dr. Wilson.
44. Hunstanton -	1,225	Norfolk - -	Dr. Copeman.
45. Ilkeston - -	19,744	Derbyshire - -	Dr. Wheaton.
46. Kidwelly - -	2,732	Carmarthenshire -	Dr. Reece.
47. Leadgate - -	4,456	Durham - -	Dr. Wilson.
48. Llanelly - -	23,937	Carmarthenshire -	Dr. Reece.
49. Loughborough -	18,196	Leicestershire -	Dr. Fletcher.
50. Louth - -	10,040	Lincolnshire - -	Dr. Bulstrode.

	Name of Sanitary District	Population Census 1891	County	Inspector
51.	Mossley	9,417	Glamorganshire	Mr. E. Evans.
52.	Menai Bridge	1,675	Anglesey	,, ,,
53.	Milford	4,070	Pembrokeshire	Dr. Reece.
54.	Minehead	1,799	Somerset	Mr. T. W. Thompson.
55.	Mold	4,457	Flintshire	Mr. E. Evans.
56.	Newark-upon-Trent	14,457	Nottinghamshire	Dr. Bruce Low.
57.	Norwich	100,970	Norfolk	Dr. Copeman.
58.	Penryn	3,256	Cornwall	Dr. Reece.
59.	Poole	15,488	Dorsetshire	Dr. Buisseret.
60.	Pudsey	13,444	Yorkshire	Dr. Hime.
61.	Ross	3,577	Herefordshire	Dr. Bruce Low.
62.	Ryton	5,553	Durham	Dr. Wilson.
63.	Sandwich	2,796	Kent	Dr. Thomas Thomson.
64.	Seaham Harbour	9,044	Durham	Mr. T. W. Thompson.
65.	Sedgley	14,961	Staffordshire	Dr. Wilson.
66.	Shildon and East Thickley.	9,537	Durham	,, ,,
67.	Skegness	1,488	Lincolnshire	Dr. Copeman.
68.	South Blyth	3,728	Northumberland	Dr. Wilson.
69.	South Cave and Wallingfen.	1,624	Yorkshire	Dr. Wheaton.
70.	Southwick	10,226	Durham	Dr. Wilson.
71.	Southwold	2,311	Suffolk	Dr. Copeman.
72.	Spennymoor	6,041	Durham	Dr. Wilson.
73.	Stalybridge	26,788	Cheshire	,, ,,
74.	Stanhope	1,864	Durham	,, ,,
75.	Stanley	7,614	,,	,, ,,
76.	Stockport	70,263	Cheshire	Dr. Bruce Low.
77.	Swanage	2,671	Dorsetshire	Dr. Buisseret.
78.	Teignmouth	8,292	Devonshire	,, ,,
79.	Tenby	4,542	Pembrokeshire	Dr. Reece.
80.	Low Law	4,554	Durham	Dr. Wilson.
81.	Towyn	3,247	Merionethshire	Dr. Reece.
82.	Walton-on-the-Naze	1,586	Essex	,, ,,
83.	Wheatley	9,174	Durham	Dr. Wilson.
84.	Whitehall	16,852	Staffordshire	,, ,,
85.	Willington	7,804	Durham	,, ,,
86.	Yarmouth	49,634	Norfolk	Dr. Copeman.
87.	Yeadon	7,396	Yorkshire	Dr. Hime.
88.	Ynysybwlmawr	5,224	Carnarvonshire	Dr. Reece.

TABLE IV.—RURAL SANITARY DISTRICTS of ENGLAND and WALES inspected during 1893, as regards their SANITARY CIRCUMSTANCES and ADMINISTRATION.

Name of Sanitary District.	Population (Census 1891).	County.	Inspector.
1. Atherstone -	15,441	Warwickshire -	Dr. Wheaton.
2. Beverley - -	10,519	Yorkshire - -	„ „
3. Carmarthen -	23,873	Carmarthenshire -	Dr. Reece.
4. Daventry -	13,709	Northamptonshire -	Dr. Wheaton.
5. Driffield - -	13,140	Yorkshire - -	„ „
6. Easington -	36,782	Durham - -	Dr. Wilson.
7. Holywell -	29,843	Flintshire - -	Mr. E. Evans.
8. Houghton - le - Spring.	31,445	Durham - -	Dr. Wilson.
9. Narberth -	18,190	Pembroke and Carmarthen.	Dr. Reece.
10. Pembroke -	11,763	Pembrokeshire -	Dr. Fletcher.
11. Sculcoates -	8,786	Yorkshire - -	Dr. Wheaton.
12. Wharfedale -	7,551	„ - -	Dr. Horne.
13. Williton - -	15,470	Somerset - -	Mr. T. W. Thompson.
14. Woodbridge -	19,960	Suffolk - -	Dr. Copeman.

App. A. No. 16.

Memorandum of June 18th, 1893, as to Cholera; by the Medical Officer.

No. 16.

Memorandum of June 18th, 1893, as to Cholera; by the Medical Officer.

Asiatic Cholera first made its appearance in England in 1831–32. Including both the epidemic of that date and the occurrence of imported cases of the disease last autumn, there have been seven occasions on which cholera has found its way to this country.

On the first four occasions, ending with the outbreak of 1866, the disease succeeded in establishing itself amongst us in epidemic form. But on the three subsequent occasions it was practically limited to imported cases, and no extension took place.

On five of the seven occasions referred to cholera travelled across Russia to Baltic ports; and when the disease has followed this route it has commonly extended also to continental ports on the North Sea and the British Channel. The disease has several times reached England from these ports, notably from Hamburg, and when this has been the case its incidence on this country has not been greatest during the first year of its European prevalence, but on recrudescence of the infection in the second, or even the third, year.

The present Memorandum does not profess to suggest any explanation of this occurrence. Neither is it intended to imply that the same sequence of events will necessarily occur again. But it may be noted that, whereas a considerable portion of the summer of 1892 was taken up with the diffusion of cholera across the continent of Europe, the disease only reaching ports on the North Sea and British Channel in the month of August, recrudescence of the disease this year along the coast line of Western Europe may well occur at a date which would involve danger to this country during a longer term of our summer and autumn season than was the case last year.

As yet there are happily no indications of any general recurrence of cholera either in the North Sea or Baltic ports; but, notwithstanding this, occasional attacks of that disease have taken place during the present year in Hamburg and in the adjacent town of Altona. In the French Department of Morbihan, Province of Brittany, cholera has hardly ceased to prevail since the beginning of November 1892. The disease is still present there; over 200 deaths having been recorded from that Department during the months of March, April, and May, of this year. The largest portion of this mortality has fallen on the port-town of Lorient. The disease has also shown itself at other points on the French coast.

Having regard to these circumstances, it is important that the Sanitary Authorities of England and Wales should be prepared in advance to prevent extension of any cholera that may be imported into their districts, and this duty devolves especially on the authorities of those districts into which cases of imported cholera are most likely to make their way.

R. Thorne Thorne,
Medical Officer.

June 8th, 1893.

No. 17.

Cholera Circular to Sanitary Authorities in the Metropolis: June 22nd, 1893.

Sir,

I am directed by the Local Goverment Board to call attention to their circular letter of 25th August last, in which, in view of the severe outbreak of cholera which was then occurring in Hamburg, they reminded Sanitary Authorities of the responsibilities and duties devolving upon them in connexion with the organisation of measures of precaution against the possible introduction of the disease into London.

I am now to forward, for the information of the Sanitary Authority, the accompanying copy of a memorandum by the Board's Medical Officer, from which it will be seen that there is reason for Sanitary Authorities preparing in advance to prevent the extension of any cholera that may be imported into their districts during the ensuing season.

The Board last year, in their circular already referred to, called attention to the powers vested in them under section 134 of the Public Health Act, 1875, and section 82 (1) of the Public Health (London) Act, 1891, to issue epidemic regulations imposing upon Sanitary Authorities the duty of making arrangements for the prevention and treatment of cholera. Those arrangements would comprise the appointment of committees for the purpose of carrying out the regulations, the divisions of the sanitary district into special areas, the appointment of medical visitors for the visitation of the poorer houses and the detection of cholera and diarrhœa, the supply of medical attendance and nursing, and of medicine and disinfectants, and the provision of dispensaries and of such additional hospitals and places of refuge as might be necessary for the several parishes and districts; the hospitals being provided for the reception of those cholera patients who could not properly be treated in their own homes, and the places of refuge for the lodgment of those persons not actually sick whom it might be right to keep under observation or to accommodate while their homes were either under disinfection or were devoted to sick persons who could not properly be removed.

As the Sanitary Authority are aware, the necessity for the issue of regulations of this nature happily did not arise last year, but in view of the possible recurrence of cholera during the approaching summer and autumn in continental ports with which this country is in rapid and close communication, the Board think it right that the Sanitary Authority should take into their early consideration the question of their readiness to meet any emergency that may arise. I am, therefore, to request that the Board may be informed, not later than the first week in the coming month, how far the preliminary action taken last year or since decided on by the Sanitary Authority may be regarded as enabling them without undue delay to perform the duties which would devolve on them in the event of the Board finding it necessary to issue regulations of the kind referred to.

I am, &c.

Hugh Owen, .
Secretary.

To the clerk to the Sanitary Authority.

Apr. A. No. 18.

Cholera (Rag) [illegible]

No. 18.

CHOLERA (RAG) ORDER, 5th August, 1893.

To all Port Sanitary Authorities ;—

To all Urban and Rural Sanitary Authorities ;—

To all Medical Officers of Health of the Sanitary Authorities aforesaid ;—

To all Officers of Customs ;—

To all Masters of ships ;—

And to all others whom it may concern.

Whereas we, the Local Government Board, by orders dated the 11th day of July, 1892, the 13th day of July, 1892, the 11th day of August, 1892, and the 14th day of December, 1892, made certain regulations with reference to ships from France, or from any foreign port in Europe north of Dunkirk other than ports of Sweden, Norway, and Denmark, or from any port on the Black Sea or Sea of Azov, whether in Russia, Roumania, Bulgaria, or Turkey, or from any other port of Turkey in Asia, having on board bales of rags, or dirty bedding, or disused or filthy clothing ;

And whereas it is expedient that the said regulations should be revoked, and that the regulations herein contained should be substituted therefor :

Now therefore, we, the Local Government Board, by this our order, revoke the regulations contained in the said orders dated the Eleventh day of July, One thousand eight hundred and ninety-two, the Thirteenth day of July, One thousand eight hundred and ninety-two, the Eleventh day of August, One thousand eight hundred and ninety-two, and the Fourteenth day of December, One thousand eight hundred and ninety two ;

And whereas the Commissioners of Her Majesty's Customs have signified their consent to the regulations herein contained so far as the same applies to the officers of Customs :

Now therefore, we do, by this our order, and in exercise of the power conferred on us by section 130 of the Public Health Act, 1875, by the Public Health Act, 1889, and by section 113 of the Public Health (London) Act, 1891, and of every other power enabling us in this behalf, make the following regulations, and declare that they shall be enforced and executed by the authority or authorities herein-after specified :—

ART. 1.—In this order—

The term "sanitary authority" means port sanitary authority, urban sanitary authority, or rural sanitary authority ;

The term "ship" includes vessel or boat ;

The term "Officer of Customs" includes any person acting under the authority of the Commissioners of Her Majesty's Customs ;

The term "master" includes the officer, pilot, or other person for the time being in charge or command of a ship ;

The terms "bedding" and "clothing" shall include such articles when torn up, but shall not include rags packed in bales and imported as merchandise.

Art. 2.—From and after the ninth day of August, one thousand eight hundred and ninety-three, and until we shall, by order, otherwise direct, no dirty bedding, or disused or filthy clothing, whether belonging to emigrants or otherwise, from France or from any foreign port in Europe north of Dunkirk other than ports of Sweden, Norway, and Denmark, or from any port on the Black Sea or Sea of Azov, whether in Russia, Roumania, Bulgaria, or Turkey, or from any other port of Turkey in Asia, shall be delivered overside, except for the purpose of disinfection or destruction, nor landed in any port or place in England or Wales, except for the purpose of disinfection or destruction.

Art. 3.—Any such bedding or clothing delivered overside or landed for the purpose of disinfection shall not be taken out of the custody of the Officers of Customs until the same shall been disinfected by and at the cost of the person having control over the same, by means of steam under pressure in such manner as to secure the exposure of every part of every article, to a temperature of not less than 212° Fahrenheit, nor until the Medical Officer of Health shall have given a certificate to an Officer of Customs as to such disinfection, which certificate shall be in the following form :—

Port of .

"I hereby certify that the [*bedding or clothing*] delivered overside or landed at this port from the ship [*name of ship*] of or from [*port of sailing*], has been disinfected at this port in accordance with the provisions of Article 3 of the order of the Local Government Board dated the 5th August, 1893.

"(Signed)

Medical Officer of Health.

"Date 189 ."

Art. 4.—Any expenses incurred by the Commissioners of Her Majesty's Customs in watching articles delivered overside or landed for the purpose of disinfection or destruction under this order shall be defrayed by the person having control over the same.

Art 5.—If any such bedding or clothing so delivered overside or landed for the purpose of disinfection shall not, within a period of forty-eight hours after being so delivered or landed, be disinfected and certified as aforesaid, such bedding or clothing shall within twenty-four hours after the expiration of such period, be destroyed by the person having control over the same, with such precautions as may be directed by the Medical Officer of Health of the sanitary authoirty within whose jurisdiction or district the same may be found.

Art. 6.—Any such bedding or clothing so delivered overside or landed for the purpose of destruction shall, within twenty-four hours after being so delivered or landed, be destroyed by the person having control over the same, with such precautions as may be directed by the Medical Officer of Health of such sanitary authority as aforesaid.

Art. 7.—If the person having control over any bedding or clothing so delivered overside or landed for the purpose of disinfection or destruction shall make default in complying with the requirements of article 5 or article 6 of this order, such bedding or clothing shall be forthwith destroyed, at the cost of such person, by such sanitary authority as aforesaid, or by or under the direction of the Medical Officer of Health of such sanitary authority acting on their behalf.

See A. No. 15.

ART. 8.—All masters of ships and other persons having control over any bedding or clothing prohibited under this order from being delivered overside or landed as aforesaid are required to obey these regulations.

ART. 9.—All Officers of Customs are empowered to prevent the delivery overside or landing of bedding or clothing in contravention of this order.

ART. 10.—It shall be the duty of the sanitary authority to take proceedings against masters of ships or other persons having control over any such bedding or clothing who shall wilfully neglect or refuse to obey or carry out, or shall obstruct the execution of, any of these regulations.

Given under the seal of office of the Local Government Board, this Fifth day of August, in the year One thousand eight hundred and ninety-three.

(L.S.)

HENRY H. FOWLER,
President.

HUGH OWEN,
Secretary.

No. 19.

CHOLERA (RAG) ORDER, 13th September, 1893.

To all Port Sanitary Authorities:—

To all Urban Sanitary Authorities;—

To all Medical Officers of Health of the Sanitary Authorities aforesaid;—

To all Officers of Customs;—

To all Masters of ships;—

And to all others whom it may concern.

WHEREAS we, the Local Government Board, by an order dated the 5th day of August, 1893, made certain regulations prescribing that from and after the 9th day of August, 1893, and until we should by order otherwise direct, no dirty bedding, or disused or filthy clothing, whether belonging to emigrants or otherwise, from France or from any foreign port in Europe north of Dunkirk other than ports of Sweden, Norway, and Denmark, or from any port on the Black Sea or Sea of Azov, whether in Russia, Roumania, Bulgaria, or Turkey, or from any other port of Turkey in Asia, shall be delivered overside, except for the purpose of disinfection or destruction, nor landed in any port or place in England or Wales, except for the purpose of disinfection or destruction;

And whereas in Article 1 of such order the terms "bedding" and "clothing" were defined as including such articles when torn up, but not including rags packed in bales and imported as merchandise;

And whereas doubts have arisen as to the meaning of the words "rags packed in bales and imported as merchandise";

And whereas the Commissioners of Her Majesty's Customs have signified their consent to the regulation herein contained so far as the same apply to the Officers of Customs:

Now therefore, we do, by this our order, and in exercise of the power conferred on us by section 130 of the Public Health Act, 1875, by the Public Health Act, 1889, and by section 113 of the Public Health (London) Act, 1891, and of every other power enabling us in this behalf, make the following regulation and declare as follows:—

The above-mentioned words "rags packed in bales and imported as merchandise" mean rags compressed by hydraulic force transported as wholesale merchandise in bales surrounded by iron bands, and with

marks and numbers showing their origin, and accepted as such by the Commissioners of Her Majesty's Customs.

Given under the seal of office of the Local Government Board, this Thirteenth day of September, in the year One thousand eight hundred and ninety-three.

(L.S.) HENRY H. FOWLER,
President.

HUGH OWEN,
Secretary.

No. 20.

Report of the British Delegates to the International Sanitary Conference of Dresden.

To the Right Hon. The Earl of Rosebery, K.G.,
Her Majesty's Principal Secretary of State for Foreign Affairs.

My Lord, Dresden, April 18, 1893.

We have the honour to report that, in accordance with your Lordship's instructions of the 7th March last, we attended the International Sanitary Conference held at Dresden. We were present at all its meetings, and took part in all its deliberations.

The countries represented were: Germany, Austria-Hungary, Belgium, Denmark, Spain, France, Great Britain, Greece, Italy, Luxemburg, Montenegro, the Netherlands, Portugal, Roumania, Russia, Servia, Sweden and Norway, Switzerland, and Turkey.

The printed Proceedings of the Conference are submitted separately.

The first meeting was held on the 11th March 1893, and this, and the three subsequent meetings, were mainly taken up by formal statements, by the different Delegates, of the Laws and Regulations in force in their respective countries, and of their application during the epidemic of last year. Some of the statements were coupled with the expression of the hope that the labours of the Conference would result in a relaxation of the restrictions to which, in many parts of Europe, traffic, whether of individuals or of merchandise, had hitherto been exposed.

At the fourth sitting we explained the policy which, for many years past, had been carried out in England with regard to the prevention of cholera, we showed the results of our practice, and, after a brief account of the circumstances which attended the importation of cholera into England last year, we pointed out that the disease had in no case extended beyond persons arriving from abroad. And at the ninth sitting, when the Conference had under discussion the Regulations for arrivals at sea frontiers, we described in some detail the application of our Cholera Regulations to English sea-ports.

To facilitate the labours of the Conference, three Committees were appointed to consider the Interrogatory submitted by the Austro-Hungarian Government, and to submit conclusions for discussion by the full Conference. Such conclusions as were adopted by the Conference were subsequently embodied in a Convention. We were represented on each of these Committees.

The First Committee was concerned with the duties imposed on a Government when cholera appears in its country. The Second Committee dealt with the measures which devolve on a Government to prevent cholera from spreading into its own territory from abroad, or from one part of its own country to another. These subjects were treated under three headings, namely, measures on land, measures on rivers, and measures by sea. The Third Committee was concerned with traffic up the Sulina mouth of the Danube.

The First Committee held four sittings. It dealt, in the main, with the information as to the existence of cholera, which each Government should secure for itself and communicate to other countries; with the reciprocal negotiations to be made between countries concerning the spread of cholera and the means taken to stay its diffusion; with the

App. A. No. 29. Report of the British Delegates (Lord Ampthill and Sir Henry Blake) to the Dresden Conference, 1893.

conditions under which any area should be regarded as infected ("contaminé"); and lastly, with the measures to be adopted in order to prevent the restrictions being imposed against an entire country when only a limited portion of it is infected.

A number of conclusions were arrived at by this Committee, and, with certain modifications, they were adopted by the full Conference at a later sitting. They embody the principle of the notification between countries of cases of cholera, and they aim at preventing certain unreasonable measures of restriction against countries in which cholera has appeared. We assented to them; but as regards a proposal to the effect that "les cas restés isolés ne feront pas nécessairement l'objet d'une notification," we expressed the opinion that the limitation of the notification to a so-called "foyer" would encourage a secrecy with regard to the onset of cholera which might materially affect the value of the notification, and that under any circumstances, England would maintain her present practice of making public every occurrence of cholera in her country.

The desire to limit the notification between countries to an actual "foyer" was, however, very general; the limitation was necessary, as was alleged, to avoid exposure to restrictions unnecessary in the case of isolated attacks of the disease; and, under the circumstances, we did not press our objections to the proposal. No satisfactory definition as to what constituted a "foyer" could be arrived at.

The Second Committee had to deal with by far the largest number of the subjects of Austro-Hungarian "Interrogatory." Thus, their labours included the definition of infected and healthy districts, the application of disinfection, and the restrictions to be imposed on traffic, whether of merchandise or of persons, and whether by land, by river, or by sea with a view to the prevention of cholera.

No district is to be considered infected, or to be the subject of restriction, until it is held to be the seat of a "foyer" of cholera, and all restrictions are to cease, subject to the adoption of certain measures of disinfection, as soon as five days have elapsed since the last occurrence of or death from cholera. But, whilst this is the case, the limitation of these restrictive measures is only to apply to countries the Governments of which take steps to prevent the exportation of articles from the infected district which are deemed to be "susceptible," *i.e.*, capable of transmitting cholera. We pointed out that, as yet, Great Britain had never been placed in a position rendering it necessary for her to impose restrictions on any articles exported from her territory for the purpose of preventing extension of cholera abroad; but as the conclusion in question is concerned only with articles coming from an actually infected district, and as it is limited to the few articles which the Convention defines as "susceptibles," we did not insist on our objections.

The term "susceptible" has indeed, under the Convention, a very limited application. It relates only to articles of clothing and bedding which have been in use, and to rags as defined by the words "chiffons" and "drilles." But some very important exceptions are made with regard to articles which in our country come under the term "rags."

Thus, it was decided that "rags" sent in bulk, and under the customary conditions which apply to rags as an article of merchandise, shall not be deemed "susceptible," and should therefore be free from all restrictions: the same exemption was made to apply to clean clippings and various similar articles, as also to woollen rags coming under the trade definitions "Kunstwolle" and "shoddy."

Some considerable discussion took place as to these exemptions, not only in the Committee, but in Sub-Committee, and at more informal

gatherings of which there are no records. As regards the interchange of views which took place at these meetings, it will suffice to say that the leading Technical Delegates present, including Professors Koch, Brouardel, and Proust, were unanimously of opinion that in no case had cholera been traced to "rags" in the form in which they are now exempted, and that risk of their conveying the infection of cholera was so remote as to justify the exemptions specified.

It was further decided that the transit through a country even of merchandise classified as "susceptible" must not be prevented if the goods are so packed that they cannot be handled on the way; that merchandise ought not to be prevented entering a country even if it had passed through an infected district, provided it had been so conveyed as to avoid contact with infected things; that no merchandise should be subject to restrictions if it could be shown that it had been despatched from an infected country not less than five days before the commencement of an epidemic; and that no merchandise ought to be retained in quarantine at land frontiers.

At one stage of our proceedings considerable difficulty arose in regard to disinfection. There was formally submitted to the Committee a proposal to the effect that the disinfection of dirty (*i.e.*, unwashed) linen which formed part of the luggage of passengers should be obligatory at the frontiers of all countries. The French Representatives maintained very strongly that this should be accepted as a definite obligation, whereas a number of Delegates, including those of Germany, Austria-Hungary, Italy, Belgium, Switzerland, and Great Britain, contended that such a practice was useless except where the articles were infected. In opposition to the alleged experience of France, that there had been no importation of cholera at her frontiers, where the practice in question had been carried out, we were able to speak to a precisely similar immunity in England, where no such action had been resorted to as regards the vast numbers of persons reaching our shores from infected countries. The matter having been discussed at great length, we submitted an amendment to the effect that such articles should be disinfected provided the local authorities had reason to regard them as having been contaminated by choleraic discharges, but this was at once met by a demand on the part of the French Delegation to the effect that a vote should be taken on the question whether this disinfection was in all cases to be compulsory or permissive. Of eighteen Delegations present, thirteen voted that it should be permissive; four, namely, France, Greece, Russia, and Turkey, that it should be compulsory: Portugal abstained.

At the opening of a sitting of the Committee on the following day the French Delegation proposed to render it obligatory to disinfect all dirty linen and other articles, provided they came from a district declared to be infected. Although this proposal was in effect the same as that which, after lengthened consideration, had been rejected in so definite a manner on the preceding day, the majority of the Delegations present had come prepared to accept it, the result being that it was adopted on behalf of all the Powers represented except Great Britain.

Having regard to the contradictory nature of the proceedings of the Committee on this subject, and to the overwhelming vote of the previous day, we felt that so sudden a change of front could have no real influence in the direction of imposing on all nations alike this useless proceeding, and, as we shall have occasion to point out under the head of maritime restrictions, we had eventually reason to find that our judgment was correct.

After deciding on a number of conclusions affecting the passage of trains and persons across land frontiers in such manner as to secure a

diminution in the restrictions which had been heretofore so commonly resorted to, it was decided that the regulation of traffic along rivers common to two or more countries should be left in each case to the respective riverain States; the Committee further recommending for adoption the Regulations drawn up by the German Government on this subject, which had in practice been found to give good results during the epidemic of 1892.

The subject of maritime measures and arrivals by sea having been now reached, a Sub-Committee was formed to prepare answers to that portion of the "Interrogatory" which related to arrivals at sea-ports. These having been drawn up, were submitted in the form of provisional propositions at the fifth sitting of the Second Committee. They prescribed, amongst other things, the treatment to which three classes of vessels, namely, "infectés, suspects, et indemnes," were to be subjected.

The first proposal related to the definition of the terms "navire infecté," "navire suspect," and "navire indemne."

It was decided that a vessel should be held to be infected if there was cholera on board, or if a case had occurred on board within seven days before arrival in port. As regards such vessels, three Regulations were laid down. In the first place, persons actually sick of cholera were to be landed, a condition to which we assented. By the second Regulation it was laid down that all other persons on board were also to be [illegible], if possible, and then subjected to a process of "observation" for a [illegible] not exceeding five days, reckoned from the date of the occurrence of the last case.

Having regard to the fact that in a subsequent Regulation dealing with suspected vessels the term "surveillance," and not "observation," was used, it was clear that the intention was to subject healthy passengers landed from an infected vessel to a definite detention in some lazaret or similar institution; in short to carry out what is known as a "quarantaine d'observation." We therefore felt it our duty to explain that, as the result of a lengthened experience, it had been decided in England that compulsory detention should be limited to those who are actually sick on arrival, and that we trusted to inland Sanitary Authorities to maintain such sanitary conditions and arrangements as would enable them to prevent the extension of the disease should any case of cholera arise subsequent to landing. And we added that our assent to the Regulation in question could only be given on the distinct understanding that the "observation" would, in the case of England, be limited to the supervision to which passengers arriving from infected vessels are subjected for a few days in their own homes by the local Sanitary Authorities. This reserve we repeated at a subsequent sitting of the full Conference, and it was inserted in the "Protocole de Signature."

The third Regulation is concerned with the disinfection of articles and of certain portions of an infected vessel. This Regulation, as first presented to the Committee, was so framed as to make it compulsory to disinfect all the unwashed linen in the trunks of passengers arriving in a vessel on which a case of cholera had occurred within the previous seven days. In short, it practically repeated the requirements already referred to in connexion with the subject of disinfection, and it was strongly insisted on by the French Delegation. The extension of this obligation to arrivals by sea was very distasteful to the German Delegation, and after an unsuccessful attempt on their part to get the French Delegation to modify the proposal, they announced to the Committee that

they could not accept it. We supported them, adding that our experience in England over a long term of years was such as to show that the requirement was unnecessary, and that, under the circumstances, we absolutely declined to be bound by any such obligation merely because another country considered it necessary in her own interests. In the end the obligation stands as limited to such articles as, in the opinion of the local Sanitary Authority, have been actually contaminated by choleraic matters. In short, the proposal made by the British Delegation when the subject was first discussed in connexion with disinfection was in substance accepted, and the corresponding conclusion already referred to in dealing with that subject was also altered in like manner. In their present form, both regulations closely correspond with the actual practice adopted in England.

Suspected vessels were next dealt with. They are defined as vessels on which cholera has occurred either at the moment of leaving the port of departure or during the voyage, but on which no fresh case has arisen for seven days. These vessels are subjected to a medical visit, to disinfection of articles actually infected, and to certain precautions concerning bilge and drinking water. A recommendation is appended as to the advisability of maintaining under supervision ("surveillance") the crew and passengers for a period of five days. As regards this suggestion, which is repeated as to vessels styled "indemnes," we explained that the practice was not likely to be deemed necessary in England, but as it came as a recommendation only, and was held to be of value in other countries, we should raise no objection to it.

A further suggestion in a like recommendatory form relates to some supervision over the movements of the crew.

Vessels styled "indemnes" were next discussed. They are defined as vessels on which there has been no death or attack from cholera. Such vessels are at once to have free pratique, even though they may have come from an infected port; and it is laid down that the regulations to which they can be subjected when coming from an infected port shall, in no circumstances, exceed those concerning suspected vessels.

The definitions of the terms "infecté," "suspect," and "indemne" agree with those in the Convention of Venice.

A few other general conclusions were adopted, such as the power to enact special regulations in the case of vessels which carry emigrants, which are overcrowded, or are in a bad sanitary condition.

There follow certain important conclusions as to merchandise. Thus, it was decided that goods arriving by sea were to be submitted to no other restrictions, whether prohibitory or relating to such matters as disinfection, than were permissible at land frontiers.

It was also resolved that any ship declining to submit to the Regulations affecting the three classes of vessels above referred to should be free to resume her journey without detention, but that any such vessel could land her merchandise under certain conditions, which will not, we trust, be regarded as needlessly irksome; and, further, that any passengers willing to submit to the Regulations affecting arrivals at the port should also be free to land.

It was further laid down that every country should provide on each of its coasts at least one port so fitted and adapted as to be able to receive vessels whatever their sanitary condition.

Meanwhile, the Third Committee was engaged on its labours. The question before it was, in substance, as follows: What sanitary restrictions should be imposed on navigation in the Sulina mouth of the Danube, and how far are the Rules of the Convention of Venice applicable to this particular case?

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At the second meeting of the Committee the principal Russian Delegate brought forward a set of Rules drawn to meet, according to his view, the special requirements of the steamers trading between Odessa and the port of Reni on the Pruth, in the Russian Province of Bessarabia, which is reached from the Black Sea by the Sulina branch of the Danube. They also professed to offer adequate security to the Roumanian Government, to whom the maintenance of the local waters in a state of purity is a capital interest, as a portion of the riverain populations—more especially the inhabitants of the town of Sulina—derive their drinking water from the stream.

It was the Russian contention that this difficulty would be met by the grant to the Odessa steamers of leave to mount the Danube to Reni "in quarantine," under guarantee of a set of restrictions to be enforced on the Black Sea by Russian medical authority, and during the ascent of the river "in quarantine" by the Roumanian sanitary police.

The Russian Delegate's proposals were elaborately drafted so as to give effect to this scheme. We do not quote them in detail, as they were rejected by M. Ghika, the Representative of Roumania, in a reply which dealt exhaustively with the points at issue by every available resource of administrative, topographical, statistical, and medical argumentation.

In objections of the last-named category lay the onus of M. Ghika's refusal. He maintained, as decisive for his Government, that the Russian proposals failed to provide those absolute safeguards for the maintenance of the purity of the river against contamination by choleraic dejections from passing steamers, which that Government regard as vital for Roumanian interests.

In presence of this apparent deadlock, the Committee charged a Scientific Sub-Committee to advise on the points at issue, and as to the conditions, if any, under which the principles adopted by the Conference of Venice in the case of the Suez Canal might be susceptible of application to the Sulina channel. The Sub-Committee included the Technical Delegates of France, Germany, Italy, Roumania, Turkey, and Great Britain. Diplomatic Representatives of Austria-Hungary and Russia were invited to attend its meetings, and supply such information on topographical or other local details as might be required.

In the discussion that ensued, the experience of Germany during the recent cholera epidemic, as to the pollution of the rivers in resort for domestic water supplies, was carefully considered. The Sub-Committee decided that between the circumstances of the Suez Canal, with its salt and brackish water and arid shores, and those of the Sulina channel, with a population drinking the fresh water from the river, no parallel could be drawn as regards the transit "in quarantine" by possibly infected vessels. Thereupon a set of rules resting on an entirely different basis was drawn up, and submitted to the Third Committee.

The measures in question relate exclusively to vessels arriving from infected ports. They are, in substance, as follows:—

All ships of that category reaching the mouth of the Danube to be [illegible] to daily medical inspection for a period which, in the absence of any occurrence of cholera on board, shall not exceed three days; all infected linen to be disinfected: certain securities to be taken in regard to the ship's drinking water and bilge water. Further, these and other allied precautions are to be carried out, and eventually repeated, according to the state of health on board, at sanitary stations to be established up the river; while all vessels ascending the Danube from Sulina must comply with certain general regulations, such as the avoidance of over-

crowding, &c., which aim at the maintenance of a reasonable standard of healthiness on board.

This scheme, being laid before the Third Committee, and some amendments of small importance having been adopted, was accepted by the Delegates of Russia and Roumania. Its conclusions were approved by the Committee, and recommended to the full Conference, which thereupon passed them by an unanimous vote. Such was the solution of that which at one time promised to be one of the most difficult problems of the "Interrogatory;" its attainment was chiefly due to the intervention of the scientific Delegates.

We have thus discussed the main conclusions adopted by the Conference, and embodied in the Convention. Some of them involve restrictions in excess of that which, according to English experience, is necessary, or even desirable, for the prevention of cholera. But as regards land and maritime traffic generally, they approach more closely to our English standard than any rules that have ever before been accepted, or even suggested, at any similar international gathering; they were only adopted by some of the consenting Delegations after repeated argument. Thus it was necessary constantly to point to the baneful influence of restrictions which give a sense of false security, and hinder the adoption of an efficient sanitary administration, which constitutes the only true safeguard against cholera. If the new measures are so carried out as neither to trespass beyond the limits of the spirit or the letter in which they are conceived, some substantial advance in the direction of the freedom to traffic both by land and by sea, and of the maintenance of a higher standard of public health in all the countries represented, will, we venture to hope, have been achieved.

We availed ourselves of every opportunity to limit the restrictions which, under the Convention, may be imposed on vessels to which some suspicion of cholera attaches. The Regulations as to this, as they now stand may be regarded both as defining a maximum and as permitting a minimum of restrictions. As regards even vessels deemed to be actually infected with cholera, the maximum restriction to which they may be subjected, if they elect to enter a given port, will involve a detention of the hitherto healthy passengers for a period not exceeding five days, as reckoned from the date of the last occurrence of cholera on board. This maximum, which does not necessarily involve the vessel itself, compares most favourably with the length of detention to which both vessels and passengers have hitherto been subjected in many foreign ports. The minimum of restrictions, which is held to be obligatory, in the case of vessels actually infected, complies, with one exception only, namely, that relating to that which is in effect a quarantine of "observation" as applied to healthy persons landing from infected ships, with the restrictions which it has long been deemed necessary to apply to such vessels arriving in English ports. And it thus happens that, subject to our reserve in the matter named, the adoption by England of the conclusions arrived at will involve no alteration whatever in the cholera Regulations under which our ports are at present administered

It must also be remembered that the number of British ships which, by reason of their having recently had cholera on board, would come within the restrictions applicable under the Convention to (1) infected vessels or to (2) suspected vessels, must be extremely small; whereas vessels held to be (3) "indemnes," will, notwithstanding the fact that they may have come from an infected port, immediately receive free pratique.

It will be observed that only three classes of vessels are referred to in the Convention, namely the "infectés," "suspects," and "indemnes,"

all of which have some relation to cholera either on board or in the ports from which they have sailed. It was not thought necessary by the Conference in any way to refer to vessels that were in no way related to any occurrence of cholera, it being assumed that since the conclusions arrived at were concerned with cholera only, no other vessels than those specified could be regarded as in any way coming within any of the restrictions allowed by the Convention. This view was assented to, but, notwithstanding, we thought it advisable to make a definite statement, which is included in the proceedings of the last sitting of the Conference, to the effect that it must obviously be assumed that no vessels other than those having had cholera on board, or having come from an infected port, would fall under any of the provisions of the Convention.

As we have already pointed out, the Convention offers advantages as regards the landing of merchandise which we trust will tend to free our commerce from some of the vexatious restrictions to which it has hitherto been so often subjected. It constitutes a considerable advance towards freedom from unnecessary restrictions. Though the Representatives of certain Powers felt it their duty to adopt an attitude of opposition to the progress involved, it is noteworthy that they often did so in an apologetic tone: some of them expressing a hope that before long their own Governments would find it possible to follow the majority of Powers represented at the Conference. On no single occasion was any proposal made to maintain quarantine in its more stringent form.

The Convention, which we have now the honour to submit to your Lordship's consideration, was signed by the Delegates of the following countries, acting as Plenipotentiaries, namely: Germany, Austria-Hungary, Belgium, France, Italy, Russia, Switzerland, Luxemburg, Montenegro, and the Netherlands.

We also have the honour to enclose a copy of the "Protocole de Signature," recording the final declarations of the various Delegations in regard to the Convention. In that Protocol we renewed the reserve we had already expressed, stating that in the United Kingdom no "observation" of healthy persons leaving infected ships will extend beyond a medical supervision carried out in their homes. No exception was taken to this reservation.

We also made a statement, for insertion in the "Protocole de Signature," that we would submit the Convention to the consideration of Her Majesty's Government.

The announcement that the Convention was not to be at once signed on behalf of Her Majesty's Government produced a certain feeling of disappointment among our colleagues, who were so as many of its provisions had been specially framed to meet our views; we therefore explained that our instructions did not admit of our taking this step as the final text of the instrument had not been settled in time to allow of our referring it to your Lordship. Under the circumstances, however, we felt ourselves justified in expressing our personal satisfaction at the great advance which had been made, and, generally, at the provisions of the Convention. Looking to the terms of this instrument we trust that we have in some measure attained the object which Her Majesty's Government had in view in appointing us to act as their Representatives at the Dresden Conference.

We have, &c.

(Signed) GEORGE STRACHEY.
R. THORNE THORNE.
H. FARNALL.

APPENDIX B.

No. 1.

Further Report on the Etiology of Typhoid Fever; by Dr. Klein, F.R.S.

I.—Differentiation of the Typhoid Fever Bacillus and Bacillus Coli.

In my report for 1892–93, I showed that the "typhoid bacillus" is, from its relations with the tissues (mesenteric glands and spleen) in enteric fever, very probably the *vera causa* of this disease. I pointed out that the view put forward by several French authorities* as to the probable identity of the common saprophyte, bacillus coli, and the "typhoid bacillus," did not get support from the large series of experiments made and recorded by me respecting these microbes. And I showed that the typhoid bacillus obtained by me from the tissues of enteric fever and the bacillus coli obtained from the healthly human intestine, can be differentiated the one from the other with comparative facility; that their fundamental differential characters are:—

(*a.*) The typhoid bacillus is longer and more motile than bacillus coli, and grows distinctly more slowly in gelatine plate cultivation than that microbe.

(*b.*) The typhoid bacillus taken from the mesenteric glands and spleen or from the dejecta of a case of typhoid fever, and grown (as a shake culture) in the depth of beef broth gelatine, never forms gas bubbles; whereas bacillus coli taken from the intestinal contents invariably forms gas bubbles under like conditions of culture.

(*c.*) The typhoid bacillus when growing in skim milk at 37° C. never produces curdling of that fluid, whereas bacillus coli curdles milk in two or at latest in three days.

(*d.*) The typhoid bacillus growing in alkaline beef broth at 37° C. does not form indol, whereas bacillus coli under like conditions of culture gives distinct indol reaction after four, five, or more days' growths in that medium.

With a view of ascertaining how far the differential characters of the typhoid bacillus and of bacillus coli are retained or are lost when these microbes are submitted for equal length of time to the same conditions outside the animal body, I instituted, in 1893–94, experiments as follows:—

(*a.*) *Behaviour of the typhoid bacillus and of bacillus coli in tap water and in distilled water.*

Two sterile flasks, No. 1 and No. 2, were charged with ordinary tap water of the laboratory. Other two sterile flasks, Nos. 3 and No. 4, charged with the same water were sterilised by boiling. And two

* Arloing, Roux, and Rodet.

additional flasks, Nos. 5 and 6, having been charged with sterile distilled water (the water was distilled into the flasks in the laboratory), were further sterilised by boiling. Each flask was made to contain about 250 c.c. of fluid. They were then dealt with thus:—

Flasks Nos. 1, 3, and 5 received each a platinum loopful of bacillus coli from a gelatine culture derived by plate cultivation directly from the normal human intestines.

Flasks Nos. 2, 4, 6 received each a platinum loopful of typhoid bacillus from a gelatine culture derived from the spleen of a typical case of typhoid fever that died at the commencement of the third week.

From day to day for the several weeks during which these flasks were kept at an ordinary temperature, plate cultures were made of the contents of each flask, and the resulting colonies were tested by sub-culture in regard to the four groups of morphological and cultural features (*a*, *b*, *c*, *d*), already referred to.

As a result, it was found that just as in the original cultures whence the organisms of experiment were derived, so also from each of the water flasks inoculated from them, *the two organisms, viz., bacillus coli and the typhoid fever bacillus, retained their differential characters unimpaired.* As long as any colonies were obtainable from the flasks of either set, the growths were easily distinguishable as those of bacillus coli and of typhoid bacillus respectively. There was never any indication whatever of modification, morphologically or culturally, of either microbe.

Incidentally a notable fact was observed in the course of these experiments, namely, that both the bacillus coli and the typhoid bacillus persisted considerably longer in the flasks that contained distilled water than in those that contained tap water. In the flasks containing distilled water both organisms, after gradually decreasing in number until the sixteenth day, began, especially about the twentieth day, steadily to increase again; so that by the end of the month, and even later, colonies of each sort were obtained from their respective flasks as readily and as numerously as in the first few days of the experiment. On the other hand, in the flasks containing tap water (whether sterilised or not sterilised) experiment could not be carried beyond 16 days, since by that time the microbes introduced had become in each instance so diminished in number as to make it difficult to recover them by plate cultivation, even when using for each plate as much as one cubic centimetre of water. I do not enter into minute detail of my recent experiments on this subject, as I am proposing to further study the behaviour of the typhoid bacillus and of bacillus coli in waters of various characters and under various conditions. For my present purpose it is enough to insist that in all the experiments which I have, so far, made there is not, when they are grown in water, the slightest evidence of alteration in the fundamental cultural characters of either the bacillus coli or of the typhoid bacillus.

That both sorts of bacillus—the typhoid bacillus and bacillus coli—can subsist in natural waters is indeed demonstrable from the facts respecting samples of water derived from particular localities in which outbreaks of typhoid fever have been found due to the public water-supply. Two such localities which have recently come within my cognizance are Worthing and Rotherham. In Dr Theodore Thomson's report on the Worthing epidemic, the results of my bacterioscopic analysis of the incriminated water are given in detail, and it is therefore

unnecessary to refer to them here.* But there are some general considerations involved to which it will be convenient to refer at this stage.

It is necessary to bear in mind that that Worthing water, having been copiously polluted with sewage, contained bacillus coli in abundance. When I say in abundance, I mean that, examining *large quantities* of the water, there was no difficulty in discovering in it, by plate culture, colonies which, on further examination by sub-culture, presented all the fundamental characters of bacillus coli. Of course, when only small quantities of a suspected water, one c.c. or less, are used for plate cultivations, bacillus coli may easily be missed. For be it bacillus coli or the typhoid bacillus that is in question, whenever drinking-water is polluted with human excrement, it always is (unless the water is exceptionally fouled) a relatively extremely limited pollution; the pollution is, moreover, as a rule intermittent, and the bulk of water as compared with the polluting matter is extremely large. In order, therefore, to discover bacillus coli or the typhoid bacillus in such water, it is obviously necessary to subject large volumes of it to examination. The method adopted by me is briefly this: — Large volumes of water (1,600–2,000 c.c.) are driven through a Berkefeld filter, and the particulate matter left on the filter is then subjected to plate culture, each plate receiving the particulate matter of 150–250 c.c. of the original water. The gelatine used for the plate cultivations is, however, previously phenolated for the purpose of inhibiting, or retarding for some days, the growth of the many saprophytes—liquefying and non-liquefying—which may occur in water, *i.e.*, bacillus fluorescens liquescens, bacillus mesentericus, proteus vulgaris, various species of cocci, &c. Meanwhile, colonies of bacillus coli or of typhoid bacillus, which organisms are not affected by this addition of phenol, have a chance and leisure to make their appearance in the plates.

When stating above that both from the Worthing and Rotherham water bacillus coli was recovered by cultivation, I mean a bacillus which in morphological and cultural respects possessed *every one* of the features mentioned above as characteristic of this organism. This is important to bear in mind, because there commonly exists in waters—I, myself, have come across it several times in waters derived from a variety of localities—a bacillus which resembles in some respects bacillus coli, but which is, nevertheless, to be differentiated from it. The water bacillus in question resembles bacillus coli in the mode and aspect of its growth in gelatine plates, on the surface of gelatine, and in gelatine in stab culture. It does not liquefy the gelatine; it is like bacillus coli, an oval or short cylindrical rod, occasionally forming a short filament, but it is distinctly more motile than bacillus coli; it does *not* form gas-bubbles in shake culture; it does *not* curdle milk, and it gives only slight indol reaction. On account of these differences it cannot be considered as the typical bacillus coli. It is this same bacillus which Weichselbaum also recognised in waters, and which he, too, distinctly differentiates from bacillus coli.

In both these waters—Worthing and Rotherham—the true and typical bacillus coli was demonstrated. And in addition, the typhoid bacillus was found in a few colonies. As to the latter, I mean a bacillus which presented the fundamental characters exhibited by the typhoid bacillus when it is obtained from the spleen of a case of typhoid fever. The bacilli in question were distinctly cylindrical, with a great tendency to form filaments. They were conspicuously motile, grew slowly in gelatine

* As to Worthing, see pp. 78–80 of present Vol.

plates, did not form gas bubbles in gelatine shake culture, did not curdle milk, and did not form indol in alkaline broth. In a word, the colonies that were isolated from the Worthing and Rotherham waters, and which were identified as bacillus coli and as bacillus of typhoid respectively, were such as possessed all those characters that I consider distinctive of the one and the other microbe.

Having thus obtained bacillus coli and the typhoid bacillus directly from sources other than the human (or animal) subject, I sought to ascertain whether these organisms, of different pedigree, so to speak, from the samples experimented with last year, would breed true under laboratory conditions. Accordingly, these samples of bacillus coli and of typhoid bacillus that I had obtained from the water supplies in question, were each studied by sub-culture in various media for more than 30 removes, simultaneously and concurrently with stock cultures of bacillus coli and of typhoid bacillus of direct human origin; and, as a result, it was found that they showed at no time any alteration in their cultural characters. For instance, in their behaviour in gelatine shake culture, in milk, and in broth, bacillus coli from normal human intestine, from Worthing and from Rotherham water, and the typhoid bacillus from the spleen of typhoid fever, and from Worthing and from Rotherham water, showed from first to last in each instance the fundamental characters which distinguish the two sorts of bacillus.

A further point in connexion with this question of fixity of type of the above organisms was next tested. As was pointed out in my report for 1892–93, intraperitoneal injection, in sufficient doses, of guinea-pigs with either the bacillus coli or the typhoid bacillus (using the bacilli themselves, not their products, for injection), causes rapid death from intense peritonitis with copious multiplication of the bacilli in the peritoneal exudation; and, as was also there pointed out, intraperitoneal injection of this exudation in further guinea-pigs causes the same intense peritonitis with copious multiplication of the bacilli. I wished, therefore, to see whether by carrying the experiment through a prolonged series of guinea-pigs—one series for bacillus coli, another series for the typhoid bacillus—the bacilli in the peritoneal exudation of the last animal of each series still presented unaltered the essential characters of the microbe that had started the series. I initiated, therefore, series of experiments as follows:—

Bacillus coli series.—Guinea-pig No. 1 was intraperitoneally injected with a large dose (one-third of a culture tube) of the bacillus coli scraped off from the surface of a gelatine culture. This animal died within 20 hours, and presented copious peritoneal exudation. With its peritoneal exudation I injected intraperitoneally another guinea-pig, No. 2, which also died within 20 hours with copious peritoneal exudation. With exudation material from No. 2, I injected guinea-pig No. 3; from No. 3 I injected No. 4; and so on until six guinea-pigs had been injected—the last of which, like the first, died in 20 hours with copious peritoneal exudation.

Of every one of these six guinea-pigs, the peritoneal exudation was used for making plate cultivations, and the colonies arising therein were tested microscopically and by sub-culture; and with the result that in the peritoneal exudation of every one of these removes bacillus coli retained its morphological and cultural characters absolutely unaltered.

Typhoid bacillus series.—This was carried out on exactly the same lines as the other. All the guinea-pigs died as before, and cultures made from the peritoneal exudation of each one of them yielded the typhoid bacillus, presenting, at last as at first, exactly the same morphological and cultural characters.

So that neither bacillus coli nor the typhoid bacillus by its passage through the peritoneum of the guinea-pig alters in the slightest degree its distinctive characters. Each remains ultimately as well differentiated from the other as at the outset.

II. The Typhoid Fever Bacillus in Relation with the Monkey and the Calf.

I next proceeded to test, on monkeys and on calves, cultivations of the typhoid bacillus derived from humam cases of typhoid fever, with a view of ascertaining whether any specific pathogenic action could be thus established in these animals. As will be remembered from my 1892–93 report the action of the typhoid bacillus on rodents, whether it be injected subcutaneously or intraperitoneally, is *not* of specific kind; it is of exactly the same nature as produced by other microbes, *e.g.*, bacillus coli and proteus vulgaris. Experiment therefore with the calf, and especially experiment with the monkey, was determined on.

A.—*Monkeys subcutaneously injected with the typhoid bacillus.*

Experiment I.—Two Rhœsus monkeys, Nos. 1 and 2, were injected subcutaneously in their groins with gelatine culture of the typhoid bacillus, from the spleen of an enteric fever case, established 48 hours previously. The growth was scraped off from the gelatine and mixed with a few c.c. of sterile salt solution, each animal receiving one Pravaz syringeful of this mixture.

Some of the main facts of this experiment are exhibited in the subjoined table :—

Date.	Temperature, in Degrees Centigrade, taken in the Evening.		Remarks.
	Monkey No. 1.	Monkey No. 2.	
Day before inoculation -	39·5	38·8	——
Day of inoculation -	39·6	39·6	——
1st day after inoculation	40·2	39·	Both eat well, and are lively.
2 days " "	40·	39·4	" "
3 " " "	39·6	39·6	" "
5 " " "	39·2	—	No. 2 found dead; No. 1 quite well.
6 " " "	39·2	—	No. 1 eats well and is lively.
7 " " "	39·	—	" "
8 " " "	39·	—	" "
9 " " "	39·1	—	" "
10 " " "	39·	—	" "
12 " " "	38·8	—	" "
13 " " "	40·3	—	" "
14 " " "	39·6	—	" "
15 " " "	39·6	—	" "
16 " " "	39·8	—	" "
17 " " "	40·	—	" "
19 " " "	38·8	—	" "

The animals showed, except a slight rise of temperature in No. 1 on the day following inoculation, no change in general health for several days; but they both had at the end of 48 hours slight swelling about the seat of inoculation, which gradually increased; in monkey No. 2 it led to the formation of an open suppurating sore. In the evening of the fourth day

this monkey became very quiet, and refused its food; on the fifth day it was apparently ill, very quiet, did not move, and did not take any food. It was found dead on the following morning. The post-mortem examination showed: an open sore in the inguinal region, with oozing of a little purulent matter; peritonitis, with sanguineous exudation; the rectum surrounded by a pyogenic pseudo-membrane, extending all over the anterior surface of the pelvic vertebral column; the spleen distinctly enlarged (about twice its normal size), its substance injected, but without marked naked-eye changes such as deposits or infarcts. Microscopic examination of the heart's blood, of the peritoneal exudation, and of the peri-rectal pyogenic membrane showed streptococci. The spleen tissue contained bacilli. Cultivations were made: (*a*) of the heart's blood, (*b*) of the peritoneal exudation, and (*c*) of the spleen tissue, with the following results:—The cultivations of the heart's blood were crowded with colonies of streptococcus, as were also those from the peritoneal exudation and from the pyogenic membrane. These colonies of streptococcus were further examined in sub-cultures, and by inoculation into the ear of rabbits. In these animals typical erysipelas was thus produced. The heart's blood, therefore, along with the peritoneal exudation and the peri-rectal pyogenic membrane, contained the streptococcus of erysipelas in abundance.

Such being the case, it became necessary to refer to the pedigree of the typhoid bacillus culture that had been injected into this monkey, and the following interesting facts were ascertained:—The gelatine culture used for the inoculation of these monkeys was a first sub-culture (a "streak" on the surface of gelatine) from the mesenteric glands of a typhoid fever patient who had died of perforation of the bowel. I re-examined, therefore, the original culture from this patient's mesenteric gland, and found that it contained, amongst a crowd of colonies of the typhoid bacillus, a limited number of colonies which on sub-culture proved to be the colonies of the streptococcus of erysipelas. I next examined the companion gelatine sub-culture of that actually used for the inoculation of these monkeys, finding here also indications of streptococcus growth; and by plate-cultivations made therefrom this streptococcus was separated from the main mass of typhoid bacilli. The conclusion to be drawn is then this: that these monkeys were inoculated not only with a large number of typhoid bacilli, but also with a limited number of streptococci of erysipelas; this indeed seems to me the only feasible explanation of the erysipelas infection of monkey No. 2. And it will be remembered, from my 1892–93 report, that in certain cases of perforation of the bowel during typhoid fever, there was positive evidence of the existence in the blood and in the peritoneal exudation of the streptococcus of erysipelas. There appears then in this monkey's case a parallel to last year's experience.

As to the spleen of monkey No. 2, this was, as has been said, found enlarged. Cultures made from it, by rubbing a small particle of the spleen tissue over the slanting surface of gelatine, showed a crowd of colonies in pure state. These were examined by sub-cultures, and they were found to be typhoid bacilli. Here again, therefore, this monkey's case was in a sense parallel to the human typhoid fever case of last year. In that case, notwithstanding the presence of streptococcus in the heart's blood, cultures from the spleen were practically pure cultures of the typhoid bacillus; and I inferred that while the latter finds in the spleen a good nidus for growth, the streptococcus cannot live and grow in that tissue.

It needs to be stated here that though these bacilli obtained from the spleen of monkey No. 2 possessed in all morphological and cultural

respects the character of the typhoid bacillus as obtained from the human subject, a few gas bubbles nevertheless appeared in the first "shake" sub-cultures made from a spleen-tube. But on subsequent sub-cultures (shake sub-culture) no gas bubbles appeared.

The small intestine of this animal showed, on post-mortem examination, nothing abnormal.

As already mentioned, there was in this monkey No. 2 an open suppurating sore at the seat of inoculation. The animal had since the third day been constantly and violently scratching the place of inoculation, and the production of the sore was a necessary sequel.

The chief point of interest in this experiment is that the typhoid bacillus had been capable, on subcutaneous injection, of establishing itself and of multiplying within the monkey's spleen, and that simultaneously with this the animal became subject of a general and fatal infection with the streptococcus of erysipelas, accompanied by a localised peri-rectal suppuration.

The companion animal, monkey No. 1, was kept under observation for over four weeks. Its swelling in the inguinal region had disappeared by the eighth day, and throughout the period of observation it remained perfectly well; it was lively and fed well. Ultimately it was killed, and no abnormal condition was anywhere discoverable; the spleen looked normal, and on cultivation yielded no growth of any kind.

Experiment II.—Two Rhœsus monkeys, Nos. 3 and 4, were inoculated subcutaneously in their groins with the companion gelatine culture to that used in Experiment I.; that is to say with a culture which was composed chiefly of the typhoid bacillus, but contained also a limited number of streptococci. The after history of the animals is noted in detail in the accompanying table, and it will be seen therefrom that, as far as the body temperature is concerned, they did not show any marked change.

Date.	Temperature in Degrees Centigrade.		Remarks.
	Monkey No. 3.	Monkey No. 4.	
Day before inoculation -	39·6	38·8	
Day of inoculation -	39·	38·8	
1 day after inoculation	39·	40·2	No. 3 has slight diarrhœa; both eat well and are lively.
2 „ „ -	40·3	40·3	Both have diarrhœa, but eat well and are lively.
3 „ „ -	39·2	39·2	Both have diarrhœa, are quiet and off their food.
5 „ „ -	38·1	39·6	Diarrhœa better, are quiet.
6 „ „ -	39·	39·2	No. 3 looks pale, has slight diarrhœa. No. 4 is well and feeds well.
7 „ „ -	38·4	39·	No. 3 still quiet, but eats fairly. No. 4 all right.
8 „ „ -	38·6	39·1	No. 3 is quiet and getting thin. No. 4 all right.
9 „ „ -	38·4	39·1	No. 3 has again diarrhœa, is quiet and pale. No. 4 all right.
10 „ „	38·2	39·1	No. 3 looks ill. No. 4 all right.
14 „ „ -	36·6	40·	No. 3 looks very ill, no diarrhœa. No. 4 all right.
15 „ „ -	35·5	40·	No. 3 found dead this morning. No. 4 all right.

The slight irregular rise of temperature observed in one or the other of the animals is no guide whatever as to their health, since a similar irregular rise was noticed in companion animals not subject to any experiment. Similarly, the looseness of bowels that is mentioned to have been observed on some days, equally occurred to other monkeys that were kept under precisely the same conditions as to locality and food, but which had not been the subjects of experiment. From my observations on monkeys during the Influenza inquiry I have come to the conclusion that, in monkeys, an occasional slight rise of body temperature and occasional diarrhœa afford no reliable indication of indisposition. There may be, and as a matter of fact there have been, both in the Influenza inquiry as also in the present Typhoid inquiry, occasional rises of body temperature with or without occasional diarrhœa in otherwise perfectly healthy monkeys, as attested by their normal liveliness and their undisturbed appetite.

Both monkeys, Nos. 3 and 4, had a slight swelling at the seat of inoculation noticeable a few days after the operation. In monkey No. 3 this disappeared by the end of a week; in animal No. 4 it led, owing to repeated and violent scratching by the animal, to an open sore, from which a little purulent matter could be squeezed out.

Monkey No. 3 (*see* table) suffered from occasional diarrhœa, the first five or six days after inoculation; it was also quiet off and on, and did not feed well. This condition, without diarrhœa, increased by the end of a week; the animal became thin, and by the twelfth to fourteenth day loss of flesh became very pronounced. The animal was found dead on the sixteenth day.

At the post-mortem examination the following was noticed. The large intestine was deeply congested, its contents fluid fæcal matter; the lymphatic glands at the mesenteric margin of the large intestine were slightly more prominent than normal; the small intestine was slightly injected in its mucous coat, and contained yellowish mucus, which under the microscope showed numerous leucocytes; the spleen was not enlarged; the liver and lungs looked in every respect normal.

Cultivations were made: (*a*) of the heart's blood; (*b*) of the lymph glands attached to the large intestine; (*c*) of the contents of the large intestine; and (*d*) of the contents of the small intestine. The result was: From the heart's blood, from the lymph glands, and from the spleen no growth of any kind was obtained. From the mucous contents of the small, and particularly from the contents of the large intestine, numerous colonies of bacillus coli were obtained; none of the typhoid bacillus. The cause of death, therefore, cannot be stated; at any rate there is no evidence that the subcutaneous injection of the typhoid bacillus had anything to do with the illness and death of this monkey.

As to monkey No. 4, this showed no evidence of disease; the local sore gradually healed, and the animal while under observation for nearly a month remained perfectly normal in all respects.

Experiment III.—Two Rhœsus monkeys, Nos. 5 and 6, were inoculated with a large dose of the bacillus of typhoid fever obtained from the spleen of monkey No. 2, half a gelatine culture tube being used for each animal. The history of their progress is shown in the accompanying table.

Date.	Temperature in Degrees Centigrade.		Remarks.
	Monkey No. 5.	Monkey No. 6.	
Day before inoculation -	39·8	39·	
Day of inoculation -	39·6	39·	
1 day after inoculation	40·	40·	No. 5 lively. No. 6 has swelling at seat of inoculation.
2 „ „ -	40·9	40·5	No. 5 lively. No. 6 has swelling at seat of inoculation.
3 „ „ -	40·2	40·5	No. 5 has slight swelling at inoculation. No. 6's swelling suppurating.
4 „ „ -	40·8	40·8	No. 5's swelling suppurating. No. 6 has an open ulcer formed.
5 „ „ -	40·5	40·9	No. 5 quiet, off its food. No. 6 quiet, off its food, diarrhœa.
7 „ „ -	39·9	39·6	No. 5 has an open sore, eats better. No. 6's diarrhœa better, feeds again.
8 „ „ -	39·2	39·4	No. 5 lively and eats well. No. 6 eats well and is lively.
9 „ „ -	39·8	39·1	No. 5 lively and eats well. No. 6 eats well and is lively.

The table bears out what has been said above as to the body temperature and occasional diarrhœa in monkeys. Monkey No. 5 was killed on the eleventh, and monkey No. 6 on the thirteenth day.

Post-mortem examination of No. 5: Extensive sore in inguinal region at site of inoculation, with much purulent matter. The spleen enlarged. All other viscera normal. Made cultivations: (*a*) of purulent matter at seat of inoculation, (*b*) of heart's blood, and (*c*) of spleen tissue. The heart's blood was found sterile. From the purulent matter at the seat of inoculation, colonies of staphylococcus albus and proteus vulgaris (very abundant) were obtained. From the spleen a few colonies (6) were obtained in one of three culture tubes, for the inoculation of which a considerable amount of spleen tissue had been used; the other two tubes remained free of growth. The colonies of the one successful culture proved to be a bacillus, which, tested by subculture, differed from or resembled the bacillus coli and of typhoid respectively in the following points: (1) in gelatine shake culture it formed, like bacillus coli, abundant gas bubbles; (2) in streak and plate culture it grew with the same rapidity as bacillus coli; (3) in morphological respects it closely resembled bacillus coli, inasmuch as it was a short oval rod, without tendency to form long threads, and was not possessed of conspicuous motility; at any rate, there were only few individuals that showed motility. In these three points then this bacillus closely resembled bacillus coli. But (4), in its inability to give the indol reaction in broth culture; and (5), in its very slight tendency to curdle milk—the milk, even after a week's exposure to 37° C. showed no distinct curdling, though it became rather thickish—it differed from the typical bacillus coli and presented characters which belong to the typhoid bacillus.

Post-mortem examination of monkey No. 6 showed all the viscera normal. Cultivations made of the heart's blood and spleen remained free of any growth.

I am unable to say what is the exact nature of the bacillus that was isolated in a very limited number of colonies from the spleen of monkey No. 5. On the whole it seems very probable that it is a variety of bacillus coli, since in most respects it resembled this microbe. It certainly did not possess the characters of the bacillus that was used for the injection, *i.e.*, that derived from spleen of monkey No. 2; nor was it the typical typhoid bacillus of the human subject.

Experiment IV.—Two Rhœsus monkeys, Nos. 7 and 8, were inoculated subcutaneously in their groins with large doses of typhoid bacillus (derived from the spleen of enteric fever) from a gelatine culture. No. 8 was affected with diarrhœa at the time of inoculation, and this condition (diarrhœa) passed off and recurred several times during the period the animal was under observation.

Date.	Temperature in Degrees Centigrade.		Remarks.
	Monkey No. 7.	Monkey No. 8.	
Day of inoculation	38·6	39·4	No. 8 has diarrhœa since yesterday.
1 day after inoculation	38·8	40·	No. 7 has diarrhœa. No. 8, diarrhœa better.
2 „ „	39·8	40·4	No. 7, diarrhœa better. No. 8, no diarrhœa.
3 „ „	37·7	39·8	No. 7, quite well. No. 8, quite well.
5 „ „	38·4	39·	No. 7, quite well. No. 8, quite well.
6 „ „	39·2	39·6	No. 7, quite well. No. 8, slight diarrhœa.
7 „ „	39·	39·2	No. 7, quite well. No. 8, diarrhœa ceased.
8 „ „	37·7	39·4	No. 7, quite well. No. 8, quite well.
„	39·	39·2	No. 7, quite well. No. 8, quite well.
„	39·1	39·4	No. 7, quite well. No. 8, quite well.
12 „ „	39·4	39·6	No. 7, quite well. No. 8, slight diarrhœa.
13 „ „	—	39·4	No. 7, killed. No. 8, slight diarrhœa.
14 „ „	—	39·1	No. 8, slight diarrhœa.
15 „ „	—	39·	„ „
16 „ „	—	—	No. 8, killed.

Monkey No. 7 was killed on the thirteenth, monkey No. 8 on the sixteenth day after inoculation. The post-mortem examination of No. 7 revealed no change in the viscera. Cultivations were made from the heart's blood, the mesenteric glands, and the spleen, but all remained sterile.

Monkey No. 8 had diarrhœa at the time of death. The large intestines contained offensively smelling fluid matter, and numerous mucus flakes, which consisted of leucocytes, and were literally crowded with bacillus coli. The mesenteric glands looked large, and when cut into were found juicy; the spleen was slightly enlarged. Cultivations were made: (*a*) from the intestinal mucus, (*b*) from the mesenteric glands, (*c*) from the heart's blood, and (*d*) from the spleen tissue. The cultivations of the intestinal mucus yielded abundant colonies of bacillus coli; those of the

heart's blood and mesenteric glands remained sterile; those of the spleen yielded colonies of bacilli, which morphologically and culturally corresponded to bacillus coli. They were short oval rods, few showing motility; in gelatine shake cultures they caused abundant formation of gas bubbles; incubated in milk at 37° C. they produced curdling; in broth culture they formed indol.

As a result then of these subcutaneous injections of culture of the typhoid bacillus into monkeys, in but a single case out of eight was there distinct growth and multiplication in the spleen of the experimental animal of the typhoid bacillus that had been injected. And beside enlargement of the spleen, no definite disease, clinically or pathologically recognisable, was produced.

B.—Monkeys fed with Culture of the Typhoid Bacillus.

Experiment V.—Two Rhœsus monkeys were fed with milk and with bread, to both of which foods, broth culture of the typhoid bacillus, derived from the spleen of enteric fever, had been added. Feeding them in this way was repeated on three successive days, a broth tube (about 8 c.c.) of typhoid culture incubated for two days at 37° C. being used for each monkey on each occasion of feeding. The animals were kept under observation, one for a fortnight, the other for sixteen days; but they remained perfectly well. After this they were killed. On post-mortem examination no lesion was to be found anywhere. Cultivations were made from their heart's blood, from their mesenteric glands, from their spleens, and from the contents of their large intestines. From the first three organs no growth of any kind was obtained; from the last bacillus coli only. No trace of the bacillus of typhoid could be discovered.

C.—Calves subcutaneously inoculated with the Typhoid Bacillus.

Experiment VI.—Two calves were inoculated subcutaneously in their groins, with broth culture of the typhoid bacillus derived from the spleen of enteric fever. This culture had been growing for four days at 37° C., and each calf received the contents of a Pravaz syringe. The animals were kept under observation for ten days, during which period they appeared in every way in good health, except that on the day after inoculation they were slightly off their food. Their temperature remained normal throughout. Both showed three days after their inoculation distinct enlargement of the inguinal lymph glands on the inoculated side. This enlargement remained unaltered until the animals were killed ten days after inoculation.

On post-mortem examination, the lymph glands near the seat of inoculation were found enlarged and juicy; their substance, however, was not markedly injected. All viscera, including the spleen, appeared normal. Cultivations were made from the heart's blood, from the juice of the inguinal lymph glands, and from the spleen. The cultivations of the heart's blood and of the spleen remained free from growth. In those of the juice from the inguinal glands numerous colonies made their appearance. They were all of one and the same kind; in respect of aspect and mode of growth, and in coverglass specimens under the microscope they appeared to be the typhoid bacillus. Sub-cultures made in gelatine streak and stab culture, in gelatine shake culture, in milk, and in broth, demonstrated that the microbe was identical in every respect with the typhoid bacillus that had been used for the inoculation.

This result, tending as it did to show that the typhoid bacillus is able, on *subcutaneous* injection into the calf, to settle, grow, and multiply,

within the inguinal lymph glands of that animal, raised question whether the tissues of the calf may not be especially suitable media for the growth and development of this bacillus. It was, therefore, thought necessary to test the point on further calves.

Experiment VII.—Two additional calves, therefore, were inoculated in the same way as in Experiment VI., and with identical results. These other calves were kept for 14 days, and were then killed. The enlargement of their lymph glands in the inguinal region of the inoculated side was distinct, but all the viscera appeared normal. Cultivations from the lymph glands yielded numerous colonies of one and the same organism; and this, on microscopic examination and in sub-cultures, proved to be the typical typhoid bacillus.

The next questions that present themselves for investigation are these:—(1.) Can the typhoid bacillus thrive and multiply in the tissues of the milch cow; and if so (2), is it at any time capable of passing out of that animal's body by way of the milk gland and the milk. As yet I have not had an opportunity of putting these propositions to the test of experiment, but in 1894–95 I hope to do so.

No. 2.

Further Report on the Antagonisms of Microbes; by Dr. Klein, F.R.S.

In my last report, 1892–93, on this subject I showed that alike by intraperitoneal and by subcutaneous injection of guinea-pigs with definite (but comparatively small) doses of the protoplasm *per se* (living or dead) of various species of bacteria, these animals can be rendered tolerant of further injection in large amount of the protoplasm; and this whether the protoplasm secondarily injected be derived from the same or from other species of microbe. The particular microbes with which I was then dealing were:—The vibrio of cholera, the vibrio of Finkler, bacillus coli, bacillus typhosus, proteus vulgaris, and staphylococcus aureus. And from the circumstance that all these microbes produce one and the same disease in the guinea-pig when their protoplasm is injected subcutaneously, and since they induce death under the same clinical and pathological symptoms when their protoplasm is injected intraperitoneally, I drew the inference that all these bacteria include the same kind of poisonous substance within their protoplasms. This I termed their *intracellular poison*, and I insisted that, as such, it must be distinguished from the *toxins* (metabolic poisons) produced by the same bacteria as a result of their processes of growth and multiplication in artificial media or in the animal body. At the same time I went on to point out that though the intracellular poisons of different bacteria may be identical, their toxins may be, and as a rule are, of diverse sorts. And further, I noted that a particular species possessing an intracellular poison of one kind may, and often does—when growing and multiplying in the animal body, or in artificial culture—form, as a result of its metabolism, a poison of a totally different nature. In reference to these considerations I cited the disease anthrax as possibly due to two poisons: the one poison the metabolic products of the bacilli which in that disease are pervading the blood and tissues; the other, the protoplasm of these bacilli themselves which meanwhile are enormously multiplying throughout the body of the affected animal. The tubercle bacillus I cited as without question concerned in two sorts of poisoning; pointing out that the sterilised intracellular substance of this bacillus—Koch's tuberculin—has a powerful phlogo- and pyogenic action, whereas the living bacilli, growing and multiplying in the animal body, elaborate from its tissues a toxin which in turn causes what are called "tubercular deposits" in the lymph glands and viscera. On the other hand I noted that tetanus and diphtheria are certainly neither of them due to intracellular poison; that in these diseases the microbes causing them remain in each instance limited to one locality of the animal body, where they multiply and produce their toxin which, when absorbed into the system, sets up the symptoms characteristic of the one or of the other disease.

In 1893–94 I have continued these researches, directing my attention to ascertaining, *firstly*, the presence or absence of poisonous substances, *i.e.*, of intracellular poisons, in the bacillary bodies of certain typical pathogenic bacteria; *secondly*, whether such intracellular poison, if it existed in a given instance, is capable of producing the disease commonly referred to the particular bacterium; and *thirdly*, whether injection into an animal body of the intracellular substance of a given pathogenic microbe is capable of preventing in this experimental animal subsequent specific infection in ordinary fashion by introduction of the same microbe.

As typical pathogenic bacteria I have chosen four microbes, each of which produces, on subcutaneous injection, in minute doses, into rodents, a different specific disease. These four are:—

(*a.*) The bacillus anthracis.
(*b.*) The bacillus of diphtheria.
(*c.*) The bacillus of fowl cholera; and
(*d.*) The bacillus of grouse disease.

In addition, I have experimented with:—

(*e.*) A bacillus producing septicæmia in the guinea-pig.

The characters of the specific diseases produced in guinea-pigs on subcutaneous injection with the bacillus anthracis, with the bacillus diphtheriæ, and with the bacillus of grouse disease, as also in the rabbit by subcutaneous injection with the bacillus of fowl cholera, are so well known that it is not necessary to recapitulate them here. The fifth (*e*) species that I used is a bacillus which acts virulently on subcutaneous inoculation of small doses of its culture into the guinea-pig. In this animal it produces acute septicæmia leading to death within four to six days. The blood of the experimental animal contains after death the bacillus very abundantly, and the spleen is congested and enlarged. This bacillus was isolated by Dr. Beaumont from a bronchial gland of a child that died of broncho-pneumonia. On culture this bacillus shows characters which place it amongst the microbes which form the great group to which belong bacillus coli, the bacillus of typhoid, the bacillus of grouse disease, &c. It is characterised by active motility in the fresh state; it is short, cylindrical in shape; it does not liquefy gelatine, though it grows thereon rapidly; it forms gas bubbles in gelatine shake culture; it forms indol in broth culture after five to eight days; it does *not* coagulate milk; and it forms a brownish-yellow, or yellowish-grey, growth on potato.

I. Bacillus anthracis.

In order to test, by intraperitoneal injection, the action of the protoplasmic substance of the anthrax bacilli *per se*, the method adopted by me last year had—with a view of avoiding at the same time the growth and multiplication of this organism within the body, thereby causing a true infection—to be set aside. Scraping off the anthrax growth from the surface of agar, distributing it in sterile bouillon, and injecting a definite quantity into the peritoneal cavity of the guinea-pig, would have defeated my object, since the introduction of even a small number of living anthrax bacilli would have ensured their rapid multiplication in the tissues of the experimental animal, and would inevitably have caused in it virulent anthrax. For the purpose therefore of ascertaining whether or not the protoplasm of anthrax bacilli contains poisonous substances similar to those contained by the microbes dealt

with in last year's experiments,* it was necessary to inject, not living but *dead*, anthrax bacilli. And in these experiments there was a further difficulty that had to be duly taken into account. It consisted in the circumstance that in any growth of bacillus anthracis that has developed on the surface of agar after incubation for 24 hours at 37° C., spores are always present; indeed after 48 hours' incubation such spores are often very numerous. Consequently the exposure (as in last year's experiments) of such a growth to a temperature of 70° C. for 10 minutes, though it would suffice to kill all the non-sporing microbes, would fail to kill any spores that happened to be present. Anthrax spores are not to be killed by exposure to 70° C. for 10 minutes; wherefore injection of an anthrax culture so treated into the peritoneal cavity or into the subcutaneous tissue of a guinea-pig, would inevitably be followed by germination into bacilli, within the animal, of spores that had escaped destruction, and the bacilli thus arising would by their multiplication and in their life processes produce a true infection, and forthwith kill the animal by anthrax. This I will illustrate by a case in point.

One third of an anthrax culture on agar was, after incubation at 37° C. for 24 hours, scraped from the surface of the medium, distributed in sterile bouillon, exposed to 70° C. for 10 minutes, and injected into the peritoneum of a guinea-pig. The animal was found dead the next day. The peritoneal fluid and the blood were full of living bacilli anthracis; and the spleen was typically enlarged and crowded with these bacilli. Since all the anthrax bacilli in the material injected had been killed by exposure to 70° C. for 10 minutes (anthrax bacilli are completely killed by exposure to 65° C. for 5 minutes), it follows that the above result must have been produced by spores of the bacilli, which, as is well known, are not affected by such temperature. As a matter of fact sub-cultures made from the above bouillon mixture after heating to 70° C. for 10 minutes, afforded colonies of anthrax bacilli.

It became therefore necessary to sterilise my anthrax cultures at much higher temperatures than 70° C. in order to kill the spores as well as the bacilli. This was effected by exposing the bouillon mixture (obtained as before, except that the agar culture of anthrax had been incubated at 37° C. for 48 hours) to 99·6° C. for 5 minutes. On testing, by sub-culture, the bouillon mixture after it had been thus dealt with, it was found to be barren of life; no anthrax colonies could be obtained.

Experiment I.—Accordingly of this bouillon mixture a definite quantity amounting to two-thirds of the scrapings from a single agar culture (the growth covered an agar surface of 6 centimetres by two centimetres), was injected into the peritoneal cavity of each of two guinea-pigs, Nos. 1 and 2. The animals appeared quite well the next day and on following days, and they continued thereafter in good health.

Experiment II.—The experiment was repeated on two further guinea-pigs, Nos. 3 and 4, using for the purpose agar cultures (as before 48 hours old) treated in the above manner. Each animal received two-thirds of the scrapings from a culture tube. The result was the same as in the first experiment, viz., the animals remained well.

Experiment III.—Two additional guinea-pigs, Nos. 5 and 6, were injected intraperitoneally with precisely the same kind of sterilised bouillon mixture of anthrax culture as in the preceding experiments,

* Koch's cholera vibrio, the vibrio of Finkler, bacillus coli, proteus vulgaris, the bacillus of typhoid, staphylococcus aureus, and bacillus prodigiosus.

each animal receiving beween one half and two-thirds of a culture tube. The result was that they both appeared rather quiet the next day, but they were again lively the following day and remained well.

From these experiments it would appear that bacillus anthracis, the classical pathogenic microbe, differs entirely as regards the nature of its intracellular substance from microbes like proteus vulgaris, bacillus prodigiosus, and bacillus coli. Considerably less than two thirds of the scrapings from a culture tube of either of these, or of Koch's cholera vibrio, or of the vibrio of Finkler, suffice, as has been shown in last year's report, when injected peritoneally, to produce in guinea-pigs severe peritonitis and generally death of the animal. But it is not so with the bacillus anthracis. In the first two experiments guinea-pigs Nos. 1 and 2, and as regards Nos. 3 and 4 also, absolutely no result at all was obtained by intraperitoneal injection of what in the case of bacillus prodigiosus or bacillus coli would be more than a fatal dose. If it be urged that inasmuch as in last year's experiments, the cultures used (Koch's vibrio, vibrio of Finkler, bacillus coli, bacillus prodigiosus, bacillus typhosus, and proteus vulgaris) were sterilised at 70°, whereas those of the bacillus anthracis, now in question, were sterilised at the considerably higher temperature 99·6° C., the answer is that sterilisation of the first set of microbes at 99·6° C. does not in any way modify their activity* ; the action on the guinea-pig of the intracellular poisons of bacillus prodigiosus, bacillus coli, and of the other microbes remains the same whether it is exposed to a temperature of 70° or of 99·6° C. So that it may be safely inferred that the intracellular substance of the anthrax bacilli is of quite a different character from the intracellular substance of the above microbes. Anthrax bacilli *per se* are barren of poisonous action, the other bacilli referred to possess on the contrary poisonous character.

The above guinea-pigs Nos. 1, 2, 3, 4, 5, and 6 were next tested as to any resistance against anthrax infection acquired by them as the result of these intraperitoneal injections with large doses of the intracellular substance of anthrax bacilli. Thus :—

After the lapse of about a week they, as well as a control guinea-pig, were injected *subcutaneously* in the groin with a small dose of living anthrax culture. The result was the production in all of them of typical virulent anthrax. It need hardly be said that this result did not surprise me seeing that the first injection with the intracellular substances had not produced any definite result ; for in last year's report it was shown that an immunity, or rather a tolerance, against a second injection was produced in the experimental animal by a primary injection of non-fatal doses (of the same or another microbe of the series) only when by such primary injection distinct illness had been established. But in the case of the bacillus anthracis no illness was produced by the injection of a large dose of the intracellular substance ; wherefore no tolerance against a second fatal dose, *i.e.*, of living microbes, was to be expected. There can be no question therefore that anthrax bacilli differ from the microbes worked with last year in the circumstance that their intracellular substance is harmless as compared with that of the others.

But not only do guinea-pigs fail to acquire by a previous intraperitoneal injection of the intracellular substance of bacilli of anthrax any resistance against a general infection with anthrax if the latter be subcutaneously injected, but they also fail to acquire by the first

* Pfeiffer has already shown that boiling does not alter the action of the cholera vibrio.

intraperitoneal injection any resistance against a subsequent infection with anthrax viâ the peritoneum. This is shown by the following experiment.

Experiment IV.—Two guinea-pigs, Nos. 7 and 8, each received per peritoneum a large dose of sterilised anthrax, *i.e.*, one-third of the scrapings from an agar tube which had been incubated 48 hours. Both animals were perfectly normal the day after the injection. These two guinea-pigs, as well as two fresh guinea-pigs, Nos. 9 and 10, were then two days later injected *intraperitoneally* with sterilised anthrax, each animal receiving half of the scrapings from an agar culture, incubated for 48 hours. All four animals were found perfectly well the day after injection, and they remained so. At the end of a week these four guinea-pigs, as also one control guinea-pig, were injected again intraperitoneally, with small doses of the spores of anthrax. All five animals were found dead of typical anthrax within 48 hours.

II. Bacillus Diphtheriæ.

Experiment I.—From one gelatine and from two agar cultures, over the whole slanting surfaces of which the bacillus diphtheriæ had produced copious growth, the colonies were scraped off, were mixed with sterile salt solution, and this mixture then exposed to 70° C. for 10 minutes in order to sterilise it completely. Next, two guinea-pigs, Nos. 1 and 2, were intraperitoneally injected therewith, each animal receiving what corresponded to the growth from one whole culture tube. On the day following their injection both animals were found quiet and a little off their food; but the next day they were again lively and fed well. They remained well during subsequent days.

Experiment II.—Two guinea-pigs, Nos. 3 and 4, received, per peritoneum as in Experiment I., each two-thirds of the sterilised scrapings from an agar culture of diphtheria bacillus. The next day both animals were quiet and off their food, but on the following day they had quite recovered.

Experiment III.—Two guinea-pigs, Nos. 5 and 6, were injected intraperitoneally as before with sterilised scrapings from an agar culture of diphtheria bacillus, each animal receiving the growth from one whole culture tube. On the following day they were quiet, but on the third day the animals were found perfectly well, and they remained so.

In this diphtheria series then there is observed the same curious result as which was obtained with the bacillus anthracis series. The pathogenic bacillus diphtheriæ, in so far as its intracellular substance is concerned, is barren of the poisonous effect which characterised the protoplasm of bacillus coli, of vibrio of Finkler, of bacillus prodigiosus, and others.

All six guinea-pigs of the above diphtheria series were, after the lapse of 10 to 12 days subjected, along with a normal control guinea-pig, to *subcutaneous* injection with living broth culture of the bacillus diphtheriæ. The result was in all cases the same, viz., great swelling, after 24 hours, at the seat of inoculation, and death in between 36–60 hours. In this respect, therefore, my diphtheria experiments and my anthrax experiments are completely parallel; in neither case by primary intraperitoneal introduction of large quantities of intracellular substance was there resistance conferred against a subsequent subcutaneous injection with the living bacilli.

Experiment IV.—Two guinea-pigs, Nos. 7 and 8, were injected intraperitoneally with *living* (non-sterilised) diphtheria bacillus, each animal receiving about one fourth of the scrapings from the surface of a gelatine culture. Both animals were quiet in the afternoon of the same day, but both seemed all right the day after. Towards the end of the week (sixth day) they again became quiet, left off feeding, and they were found dead on the eighth day. In the peritoneal cavity of each was found a small amount of turbid sanguineous exudation. This was tested by cultivation; but though numerous colonies of proteus vulgaris came up, no diphtheria bacilli could be recovered. So that from this experiment it would appear that on injecting large doses of living culture of diphtheria bacillus into the peritoneum of guinea-pigs there does not occur that local multiplication of the bacilli which is observed after subcutaneous injection of the microbe. This experiment was undertaken as a preliminary to other experiments which were to be directed to ascertaining whether a guinea-pig that has been injected intraperitoneally with the intracellular substances of this bacillus has thereby acquired resistance against subsequent intraperitoneal injection of the living bacillus; for of course it was first of all necessary to ascertain the result of *intraperitoneal* injection into the guinea-pig of the *living* bacilli, since experimental infection of guinea-pigs with diphtheria has hitherto been commonly induced in the laboratory by subcutaneous injection. The result of the above experiment was then not satisfactory, inasmuch as injection per peritoneum of living diphtheria bacilli did not act in the same acute manner as the subcutaneous injection of this organism. Nevertheless:—

Experiment V.—Two guinea-pigs, Nos. 9 and 10, were injected intraperitoneally with *sterilised* diphtheria scrapings from an agar culture, each animal receiving the scrapings of about one-half a culture tube. They remained well. Five days after they, as well as a control guinea-pig, were injected, also *intraperitoneally*, with a syringe full of broth culture of *living* diphtheria bacilli. Guinea-pigs Nos. 9 and 10 remained perfectly well, but the control animal was dead in 48 hours. Now since the control animal died, whereas the other two guinea-pigs remained well, it might seem that the first intraperitoneal injection had conferred on these latter resistance against diphtheria infection. But the death of the control animal does not necessarily support such inference, for the reason that the broth culture used contained chemical metabolic substances, which by themselves, and apart from the bacilli (as was shown by Roux and Yersin's researches), act poisonously on the guinea-pig. Indeed, a whole Pravaz syringe full of such a culture is sufficient, independent of the contained bacilli, to kill several guinea-pigs, and the death therefore of the control guinea-pig may be thus accounted for. And in this connexion it is significant that from the viscid peritoneal exudation of this control guinea-pig no cultures of diphtheria bacilli could be obtained. The survival of the two guinea-pigs Nos. 9 and 10 may therefore indicate, not so much resistance to subsequent living infection, as resistance against the metabolic products of the bacilli when these are introduced intraperitoneally. The question as to any real protection required by guinea-pigs Nos. 9 and 10 was therefore further tested.

Experiment VI.—The above two guinea-pigs, Nos. 9 and 10, were now injected *subcutaneously*, each with large dose (quarter of a culture) of living bacilli that had been scraped from the surface of a gelatine tube. At the same time one control guinea-pig, (*a.*), was injected *intraperitoneally*, while a second control guinea-pig, (*b.*), was *subcutaneously* inoculated, each with a like amount of the same culture.

The result was interesting. Control guinea-pigs (*a.*) and (*b.*), and guinea-pig No. 9 were found dead within 40 hours; while guinea-pig No. 10 died in 50 hours. Moreover control guinea-pig (*b.*) and guinea-pigs Nos. 9 and 10 had each of them the usual hæmorrhagic swelling at the seat of inoculation; so that by this experiment it is demonstrated that guinea-pigs Nos. 9 and 10 were not possessed of resistance against the infection of diphtheria administered to them in ordinary fashion.

III. Bacillus of Fowl Cholera.

Experiment I.—Cultures were established on the surface of agar with the blood of a rabbit that had died after inoculation with material from typical fowl cholera. The growth which appeared in the agar tubes was scraped off and distributed in broth, and a droplet of this mixture, containing the microbe in living condition, was injected into the subcutaneous tissue of a (control) rabbit. The rest of this mixture was then sterilised by heating it at 70° C. for 10 minutes, after which two rabbits, Nos. 1 and 2, were injected intraperitoneally therewith, each rabbit receiving what amounted to the scrapings of one whole culture tube. Next day rabbits Nos. 1 and 2 were found quite well, and they remained so; the control rabbit, on the other hand, was found dead from typical fowl cholera.

Experiment II.—The like experiment was repeated on two further rabbits, Nos. 3 and 4, each animal receiving per peritoneum the sterilised bacilli scraped from two agar cultures. The result was that both animals were found lively and well the next day, and they remained so.

All four rabbits were then, six days later, tested by inoculating two (No. 1 and No. 3) *subcutaneously*, and other two (Nos. 2 and 4) *intraperitoneally* with a small quantity of living bacillus of fowl cholera scraped from the surface of agar culture. As a result, all four rabbits were found dead the next day of typical fowl cholera.

Experiment III.—Three rabbits, Nos. 5, 6, and 7, were injected intraperitoneally with sterilised culture of bacillus of fowl cholera, each animal receiving two-thirds of the scrapings from an agar tube. They remained perfectly well. After five days all three animals and one control animal (No. 8) were injected *intraperitoneally* with living culture of this bacillus. All four animals were found dead of typical fowl cholera within 48 hours.

Here then is illustrated in a still more striking manner the same experience as before. The highly virulent and specifically pathogenic bacilli of fowl cholera do not possess in their intracellular substance any poisonous material. Large doses thereof—as much as the whole scrapings from a culture tube—introduced per peritoneum have no effect whatever on rabbits; such injection is incapable of preventing in these animals subsequent typical infection, whether by subcutaneous or by intraperitoneal administration.

IV. Bacillus of Septicæmia of the Guinea-pig.

The growth having been scraped off the surface of agar cultures of this bacillus, and distributed in sterile bouillon, a few drops of the mixture were, as a preliminary experiment, injected, *subcutaneously* into one, and *intraperitoneally* into a second, guinea-pig. The latter was found dead the next day, the former on the third day. In both cases the spleen was enlarged, and the blood full of the microbes. As

soon as the above control guinea-pigs had been injected, the bouillon mixture was sterilised by exposure to 70° C. for 10 minutes, and then used for injection into the *peritoneal* cavity of two guinea-pigs, Nos. 1 and 2. The quantity used for each animal amounted to the scrapings of half of a culture tube. The result was *nil*, both animals remained well. Next, both these guinea-pigs, as well as a control guinea-pig, were on the sixth day subjected to *subcutaneous* injection with a few drops of a living culture of the septicæmia bacillus. Guinea-pig No. 1 died on the third day, at which date guinea-pig No. 2 was ill, and had a big swelling at the seat of inoculation. This animal became daily weaker and weaker, and ultimately died on the eighth day. The control guinea-pig, which had a big swelling at the seat of inoculation, died on the fifth day.

In the case then of the bacillus of septicæmia of the guinea-pig, there is also demonstration of absence of poisonous property in the intracellular substance of the bacilli.

V. The Bacillus of Grouse Disease.

This organism has been shown by me* to be pathogenic to the guinea-pig. It is capable of producing in that animal, on subcutaneous injection of moderate doses, acute disease and death, with multiplication of the bacilli in the blood. Only about 50 per cent., however, of the animals thus injected in moderate dose actually succumb; the rest show only a swelling at the seat of inoculation, which, having gradually enlarged, becomes firm, then smaller, and disappears altogether in 10 to 14 days from the date of injection. Small doses (two to three drops of recent broth culture) as a rule produce death in a small minority only of the animals. So that, so far as the guinea-pig is concerned (mice are much more susceptible), this bacillus is not as regards its pathogenic action to be compared with the bacillus anthracis. When, however, guinea-pigs are injected in their *peritoneal cavities* with a trace (one loop) of the living growth taken from the surface of an agar culture 48 hours old, they die within 20 hours from acute intensive peritonitis, the exudation and the heart's blood being crowded with the bacilli.

In order to see how intraperitoneal injection of the sterilised intracellular substance of these bacilli affects the guinea-pig, the following experiments were made.

Experiment 1.—Agar cultures of the grouse bacillus were incubated for 48 hours at 37° C., by which time the surface of the agar was covered with a thick layer of colonies of the micro-organism. This growth was scraped off and distributed in sterile bouillon, and the mixture itself sterilised by exposing it for 5 minutes to 75° C. One guinea-pig, No. 1, received then per peritoneum what amounted to two-thirds, another, No. 2, one third of the growth from one culture tube. On the day following the experiment both animals were found quiet and off their food. In the morning of the third day, *i.e.*, before 48 hours had elapsed, No. 1 was found dead, No. 2 still remaining at this date quiet and off its food. The post-mortem examination of guinea-pig No. 1 showed copious hæmorrhagic exudation into the peritoneal cavity, with lymph and pseudo-membranes on the omentum and the liver; that is to say, there had been produced in this guinea-pig the same acute intensive peritonitis which was produced in other animals last year by intraperitoneal injection of large doses of the sterilised protoplasm of bacillus coli, of bacillus

* Grouse Disease, Fowl Enteritis, &c. Macmillan, 1892.

prodigiosus, and of other bacteria. And, as was to be anticipated from my former experience, the peritoneal exudation of this guinea-pig No. 1 contained no living bacilli: cultures made from it remained sterile. Guinea-pig No. 2 recovered; it was quite well on the sixth day.

Experiment II.—Two guinea-pigs, Nos. 3 and 4, were similarly injected intraperitoneally with sterilised agar culture of the bacillus, each animal receiving about two-fifths of the scrapings from a culture tube. Both animals were quiet and off their food the day following the experiment, but on the third day they were seemingly all right again.

Experiment III.—Two guinea-pigs, Nos. 5 and 6, were injected intraperitoneally with the sterilised bacilli, each animal receiving about two-thirds of the scrapings from an agar culture. One was found dead the next morning, and the other, which looked very ill, died on the fourth day. The post-mortem appearances in both cases were the same as in guinea-pig No. 1 of this series.

From these experiments it appears that two-thirds of the sterilised scrapings from a culture of the grouse bacillus administered intraperitoneally to guinea-pigs acts fatally, and that the same material injected in smaller amount produces only a transitory illness, from which the animals recover. This indicates that the grouse bacillus, so far as its intracellular substance is concerned, comports itself more in the manner of bacillus coli and bacillus prodigiosus; which indeed was to be anticipated from the fact already recorded, namely, that it possesses only a limited specific pathogenic action on the guinea-pig.

The other three guinea-pigs, No. 2, No. 3, and No. 4, that had recovered were next subjected to test as to whether they had, as a result of their intraperitoneal injection, acquired any power of resistance against a *subcutaneous* injection of living culture of the grouse bacillus. These guinea-pigs, and as well a control guinea-pig, were injected *subcutaneously* with recent broth culture, each receiving the same quantity, about five divisions of a Pravaz syringe. All four animals were found quiet and off their food the next day; especially the control guinea-pig, which was very ill, and on attempting to move shook a very great deal. This control animal was found dead in the morning of the third day, but the other three, though still quiet, had by this time recommenced feeding, and they were seemingly quite well again by the fourth or fifth day.

Experiment IV.—I now sought to ascertain whether a first intraperitoneal injection of the (sterilised) intracellular substance of the grouse bacillus protects against a second *intraperitoneal* injection of the living bacillus. Two guinea-pigs, Nos. 7 and 8, were therefore injected intraperitoneally with sterilised bacilli, each animal receiving one-third of the scrapings of an agar culture. The day following they were quite well. Five days later these two animals, and two additional guinea-pigs, Nos. 9 and 10, were injected intraperitoneally with similar sterilised culture, each animal receiving a quarter of the scraping from an agar culture. On the following day all four animals were found well. After lapse of further five days, thes four animals were again injected intraperitonally, this time with *living* culture, each animal receiving as before a quarter of the scrapings from an agar tube, while at the same time two control guinea-pigs received intraperitoneally each one-twelfth of the scrapings from a similar culture. The two control guinea-pigs were found dead within 48 hours; but the other four guinea-pigs were lively and well, and they remained so.

Upon the whole, then, the bacillus of grouse disease behaves more like bacillus coli and bacillus prodigiosus than like the anthrax bacillus

of the bacillus of fowl cholera:—an intraperitoneal injection in definite amount of intracellular material, furnishes the experimental animal with resistance alike against a dose which, whether administered subcutaneously or intraperitoneally, would in a control animal certainly prove fatal.

I next sought to ascertain in regard of each of the above five microbes: (1) Whether *subcutaneous* injection of their sterilised protoplasm into rodents caused in these animals any illness; and (2) whether such procedure afforded them protection against subsequent *subcutaneous* injection of the living bacillus.

Subcutaneously injected no action of any kind is produced by large doses of the intracellular substances (sterilised bacilli) of any of the foregoing microbes; the experimental animals remain perfectly well. And, on the other hand, no resistance is thus produced against injection of living bacilli; all animals prepared in the above manner succumb, exactly like the control animals, to a further subcutaneous injection with the living bacilli.

Summarizing the results of these experiments, two facts, I think, stand out very conspicuously.

(1.) Unlike Koch's cholera vibrio, Finkler's vibrio, bacillus coli, the typhoid bacillus, the bacillus prodigiosus, and the proteus vulgaris, injection into the peritoneal cavity of guinea-pigs of large doses of the intracellular substances of bacillus anthracis, of bacillus diphtheriæ, and of bacillus of fowl cholera respectively, does not exert poisonous action.

(2.) A previous administration per peritoneum of large doses of the intracellular substances of bacillus anthracis, of bacillus diphtheriæ, and of bacillus of fowl cholera respectively does not confer on guinea-pigs any immunity whatever against, or even tolerance of, a further injection with the living microbes.

(3.) The bacillus of grouse disease differs from the other four microbes that have this year been subjected to experiment, in that, like Koch's cholera vibrio, Finkler's vibrio, bacillus coli, bacillus prodigiosus, and proteus vulgaris, a previous administration per peritoneum of large dose of its intracellular substance does confer on the guinea-pig tolerance of further injection, whether subcutaneous or intraperitoneal, of the living bacillus.

No. 3.

Report on Psorosperms in their Relation to the Etiology of Cancer; by Dr. Klein, F.R.S.

One of the most fully studied of the animal diseases that are caused by psorosperms or sporozoa, is a well-known chronic nodular disease of the liver and of the alimentary canal of the rabbit. The researches of Leukart, Virchow, Malassez, and others, have given us a comprehensive account of the nature of the parasite (coccidium oviforme of Leukart) concerned; of its life history within and outside the animal, and of the hypertrophic changes it causes in the epithelium of the intestine and of the liver.

This parasite, it appears, lives and thrives within and at the expense of the epithelium, at the same time causing the epithelium to rapidly proliferate. In consequence of its attacking the bile ducts of the liver, it causes a great hypertrophy of their epithelium; the bile duct becomes greatly distended, its wall thickened and folded; and, as a result, numbers of white nodules, at first small, then gradually increasing in size, appear throughout the liver. These distensions become converted into more or less irregular cysts, and from their walls of thickened membrane a number of larger and smaller folds covered with hypertrophied epithelium project into their interiors, which are in effect sections of the original cavity of the bile duct. Between and within the cells of this hypertrophied epithelium sporozoa, the coccidium oviforme, are found growing and multiplying. As the process advances, larger and larger zones of the adjoining liver tissue atrophy, and ultimately the animal succumbs. The presence of the coccidium oviforme in the liver of the rabbit is solely responsible for this distinct hypertrophy of the epithelium of the bile ducts.

Another disease in which the presence of psorosperms, or at any rate of parasites morphologically related to them, causes a chronic thickening and hypertrophy of epithelial structures, has been described by L. Pfeiffer (die Protozoen als Krankheitserreger) as occurring in the fowl. This animal is occasionally found to show on its skin in various parts of the body, large and small prominent nodules which consist of greatly hypertrophied epidermis (stratum Malpighii) with corresponding infiltration of leucocytes and distension of the blood vessels of the subjacent corium. The disease in question—epithelioma contagiosum of the fowl—is not at all of rare occurrence, and when it occurs on a farm it generally spreads to other fowls. I have myself met with several such instances. Sections made through the nodules show an enormous local

hypertrophy of the stratum Malpighii of the epidermis; and amongst the epithelial cells, in many places within these cells, are found oval bodies, mostly capsulated, which are distinctly of the nature of psorosperms. On staining the sections in fuchsin, and then washing in alcohol or dilute nitric acid, the epithelium is decolourised and leaves the psorosperms stained pink; in this manner the psorosperms, with their pink protoplasm, their capsule and clear nucleus, can be easily recognised. It is not a question of finding such a psorospermic corpuscle here and there; the epithelium is pervaded by them in almost continuous masses. They are found isolated within the epithelial cells, destroying the substance of these latter; or, when the epithelial cells are almost destroyed over extensive areas, the psorosperms are found to have entirely replaced them. There is not the slightest difficulty in recognising these psorosperms and in differentiating them from the epithelial cells. This disease in the fowl is, like the psorospermosis of the liver in the rabbit, essentially a chronic hypertrophy of the epithelium caused by the process of growth and multiplication of the psorosperm parasite.

Now, there are recognised in the human subject a number of chronic diseases which consist essentially in a chronic hypertrophy, with ultimate destruction, of the epithelium of the skin, and of various mucous membranes. The principal of such diseases are known as: Darrier's disease, molluscum contagiosum, Paget's disease of the nipple of the breast, and last, but not least, various forms of epithelioma and cancer of the skin, mucous membranes, &c. The number of observers who have searched for and found in these various chronic epithelial disorders parasite-like bodies comparable to psorosperms is legion; but it is equalled, if not surpassed, by the number of other observers, who, though they have searched for these alleged psorosperms in these diseases with equal care and perseverance, have utterly failed to identify them.* While, however, it is one of the simplest and easiest things to demonstrate, by a microscopic examination of the above-mentioned nodular disease of the rabbit, not only the existence of the psorosperms but their relation also to the hypertrophy of the epithelium, it is quite another affair to obtain anything like clear evidence of similar conditions in the above-named human diseases. In the first place, amongst the number of observers who affirm that they have discovered psorosperms in epithelioma of the human subject, there are scarcely two who describe the same parasite; while not one amongst them is able to do more than draw attention to certain morphological appearances in the epithelium which are put forward as denoting the presence of something extraneous to the typical epithelial cells. No one has in regard of cancer ever succeeded in isolating the parasite, as is easily enough done in the psorospermosis of the rabbit; and, all assertions to the contrary, the evidence amounts only, as I have said, to description of certain bodies which, after certain methods of staining, can be demonstrated within or between the epithelial cells in the above human affections. Amongst these bodies, however, none are typical psorosperms. Under these circumstances the critics of those who affirm a parasite cause of cancer have an easy task; they can with perfect justification demand, where—if such-and-such indefinite and mysterious bodies do occur in cancerous epithelium—is the proof that they are of a parasitic nature. To this the others can only reply that they are most probably parasites, because they are not typical epithelial cells. But how do you know that they are not

* An excellent summary of all these researches is given by Strœbe in the "Centralblatt für Allg Pathol," &c., 1894, nos. 1, 2, and 3.

part of the cell or nucleus, again ask their critics? Because they stain differently from epithelial cell substances or epithelial nucleus, answer the upholders of parasitic cause. But surely, retort their critics, you have no right to call those bodies psorosperms merely because you are unable to think of them as derivatives of the substance of the epithelial cells or their nuclei. And so on, and so on.

I have I think thus given sufficient account of the general nature of great part of the controversy; at least it is not necessary for the present to go further into details, as will duly appear later on.

Before coming to the discussion of the alleged parasites of cancer and of other chronic epithelial diseases in man that I have referred to, it is necessary to have a clear view of the elements of the problem that has to be dealt with; indeed, to everyone who has devoted any considerable amount of attention to pathological histology in general, and to the changes of the epithelium in health and disease in particular, it will be clear that insistence on this necessity is by no means uncalled for. By going carefully over the descriptions and illustrations of the "cancer parasites" put forward by different observers, it is quite obvious that a considerable number of them have thought it sufficient, having made a few sections of cancer material, and having stained and mounted them, to at once declare without hesitation—and regardless of the histology, normal and pathological, of epithelium—that such-and-such a particle or corpuscle present in the substance of the epithelial cell or in its nucleus, is a parasite. As to this, I illustrate my meaning as follows:—

Podwyssozki and Sawtschenko published in the "Centralblatt f. Bakt. und Parasit," vol. xi., nos. 16, 17, and 18, a paper on cancer psorosperms, and they add two coloured plates (Plates VII. and VIII.) illustrating the presence of the alleged sporozoa within and between the epithelial cells. Now, anyone who, after staining them, has examined sections of well-preserved epithelial structures, growing and proliferating under normal and under pathological conditions, will recognise in the figures given by these authors appearances very commonly met with: viz., bodies, variously shaped and variously sized, contained within the cells; bodies, indeed, which take the stain differently from the typical nucleus of the epithelial cell. These bodies are commonly and justly considered to be derivatives of the nuclear substance, particularly of that portion commonly called chromatin. Appearances such as are shown by the authors in their Figures 1–7, 11–15, 16–20, &c., are to be met with within the epithelial cells in sections through normal glands, as also in sections of the skin and of oral mucous membrane, in normal and (better still) in pathological states. The epithelium of cancer is not required for demonstration of these bodies, though in cancer—owing no doubt to extensive multiplication of the epithelial cells—they are met with sometimes, but by no means always, as copiously as these authors would imply. Why, therefore, they should consider these bodies, coccidia, is not easy to understand.

Another and perhaps more striking illustration of the same tendency is afforded by Soudakewitsch in "Centralblatt f. Bakt. und Parasit," vol. xiii., page 415, Plate 1. He describes there, as parasites, intracellular nucleus-like bodies, which most histologists, with experience of normal and pathological epithelium, would have no difficulty in identifying as chromatic and other derivatives of epithelial nuclei.

To quote one more instance: In vol. i., p. 198, of the "Journal of Pathology and Bacteriology," Drs. Ruffer and Walker describe and figure epithelial cells, in which the main part of the cell substance is

occupied by a vacuole, while within this vacuole lie three round clear cells, each with several nuclei. Most histologists recognise these at once as vacuolated epithelial cells containing common leucocyte, such indeed as are commonly found in epithelium under pathological conditions, and normally in certain localities, *e.g.*, fauces, tonsils, and tongue. Such vacuolated epithelial cells containing leucocytes have been familiar to histologists for many years; they were the very cells about which, 17 or 18 years ago, a considerable amount of discussion arose. The question then under debate was: whether they are endogenously developed within the inflamed epithelium (Stricker, Rindfleisch, and others); or whether, as Cohnheim and others maintained, and as is now universally believed, they are immigrants into the epithelium and into the epithelial cells themselves. As matter of fact, they are found easily in the epithelium in gonorrhœa and in the conjunctiva in catarrhal (blenorrhœal) inflammation.

Messrs. Ruffer and Walker meeting, in cancer, with vacuolated epithelial cells enclosing several leucocytes, seem to assume that there has originally been a parasite within each such epithelial cell, which has been eaten up by the leucocytes ! ! ! And in this way it could be shown that, in a considerable number of instances, belief has arisen of the existence of coccidia, psorosperms, and other parasitic forms in cancer epithelial cells. Those enunciating such belief would seem to be wanting in a clear understanding of the elements of the problem with which they are concerned; for in dealing with purely morphological questions, such as the presence or absence of certain bodies in the hypertrophied epithelium constituting cancer and similar chronic epithelial diseases, it is obvious that a critical apprehension of what appertains to cancerous epithelial new-growths *and to no other epithelium in health or disease*, is necessary as an elementary condition for proper study of the subject. And let me here at once say, in making this statement, that I am in no way disinclined to regard molluscum contagiosum, Paget's disease, and cancer as belonging to the group of infectious diseases that are of parasitic origin; all that I wish to insist on is that many, if not most of the assertions as to the actual demonstration of the presence of coccidia, psorosperms, and similar parasites in cancer and in allied diseases, are not founded on anything like admissible evidence.

I now proceed to analyse in detail certain histological facts recorded by various observers, and to add thereto the observations which I myself have made in regard to epithelial cancer.

A careful examination of suitably prepared sections through epithelial structures, such as the epidermis of the skin, the mucous membrane of the mouth, fauces, and pharynx, and of glands (salivary glands and pancreas), after hardening in Flemming's solution and staining in fuchsin and methyl blue, or in rubin and methyl blue, reveals the fact that there are epithelial cells among which there occur, here and there, cells which deviate from the normal and typical appearance. These deviating epithelial cells do not contain the single characteristic nucleus with the more or less spongy or filamentous intranuclear network including large or small chromatin granules-nucleoli; but instead they contain a slightly transparent nucleus, and also a circular or oval, generally well defined, homogeneous body slightly smaller than the typical nucleus. These two lie close together, but they stain differently; in sections stained with rubin and methyl blue the nucleus is blue, while the other body is pink; and they differ in the same way where the sections are stained in fuchsin and methyl blue. This other body corresponds, most probably,

to what was first observed by Balbiani in ovum cells as a paranucleus, and was observed also by Grützner in the gland cells of the pancreas; and it requires only a careful study of other epithelial structures to find in them here and there (sometimes very sparsely, at other times in greater amount) cells which, besides a principal nucleus, contain something which corresponds to a paranucleus. That this paranucleus is really derived from the principal nucleus, notwithstanding the different manner in which it stains, is evinced by the following facts:—(*a*) its juxtaposition and close relation to the former; and (*b*) the circumstance that the principal nucleus is in these cases always more transparent and contains less of the chromatic substance than is contained in those cells which are free of a paranucleus.

Another point which is important to mention in this connexion is that, the more distinct evidence there is of growth and reproduction going on in the epithelium, as shown by the presence of karyomitotic figures, the more likely are cells to be met with which contain such a paranucleus. I have examined, in this direction, sections through the skin and mucous membrane (palate and tongue) in inflammation, after the acute inflammatory process has subsided, and have found among epithelial cells, and also among the connective tissue cells in the superficial corium, swollen cells in which, besides the principal nucleus, there was present the above-named paranucleus. I possess sections through the skin of inoculated sheep-pox in the stage of vesiculation, wherein the marginal portion of the pock outside the vesicle is covered with thickened epithelium, and in which every epithelial cell of the stratum Malpighii, and every connective tissue cell in the marginal part of the tissue, shows a principal nucleus and a paranucleus—the former stained blue, the latter pink. These appearances are uniform and very striking. In these cases it is generally noticed that the principal nucleus appears hydropic, *i.e.*, clearer and containing less chromatin than normal, and that by its distinct membrane being stained blue (methyl blue) it is in marked contrast with the paranucleus, which is less sharply outlined and is stained pink (rubin); in some cells this pink body contains one or more granules. This is an extreme case, but, as I have already mentioned, similar cells with paranucleus stained differently from the principal nucleus are to be met with in other conditions, both in health and particularly in inflammation. But it might be nevertheless argued that in the above case of sheep-pox, this second intracellular (pink) body is possibly a parasite, as it corresponds to some of those figures represented by particular observers in the epithelial cells of cancer as spores of psorosperms. To this I can only answer that, if so, it is very remarkable to find every epithelial cell and every connective tissue cell of the peripheral part of the pock containing one and the same kind of additional body. One could, indeed, accept *a priori* the parasitic nature of this secondary body if it occurred exceptionally only in epithelial cells; but it is out of question to accept this view when one finds it in every epithelial cell and in every connective tissue cell. And further, be it observed, it is everywhere of exactly the same kind, and the cell substance in every instance is of a uniform normal character. In addition, it completely resembles the body found in some epithelial cells under conditions already noted, wherein the presence of a parasite is seemingly quite out of the question.

Hence, it appears that occasionally, in epithelial and in other cells, there occurs, besides the principal nucleus, and more or less close to it another body which, though it stains differently from the nucleus, is in many

ways to be regarded as its derivative. For this reason I retain for it the name of paranucleus. This then is the first obstacle to acceptance of many of the assertions as to the presence of an intracellular nucleus-like parasite in cancer cells; namely, *no account whatever is taken of this paranucleus.*

A second obstacle is this: Examination of the epithelium in a variety of states, particularly under pathological conditions, shows cells in which small, generally round, particles of the cell substance are separated from the main body. This separation is accentuated by the presence of a clear zone around each such particle, as if by the formation of a vacuole around it. As a matter of fact, such appearances are met with more numerously where there is not only rapid new formation of young epithelial cells, but at the same time a retrograde change among other and older cells, as is evinced by the dropsical condition of their nuclei and the loosening and separation of such cells from their neighbours. The particles thus separated either take the stain as the rest of the cell substances, or they take it in a different tint; but between the two states all gradations can be made out. This separation of particles of the cell substances by clear vacuoles, is sometimes so extensive that a large part of the cell substance seems broken up into such discoid particles, small and large, almost every one of which is enclosed in its separate vacuole. These appearances are of particular interest in reference to the statements repeatedly made as to the presence of small spores of sporozoa, singly and in groups, within the substance of the cancer epithelial cells (Sjöbring, Soudakewitsch). But there are also epithelial cells, in which the main part of the cell substance is as a whole separated from the marginal part by a clear zone; it then looks as if a spherical protoplasmic mass, including the nucleus, were enclosed in a capsule. This by some writers on cancer parasites is described as an encysted nucleated sporozoon. But as stated just now, this appearance is to be met with in a variety of pathological conditions of epithelial structures. Such condition of affairs, viz.: separation by a clear zone of the main central part of the substance of the epithelial cell (including the nucleus) from the marginal layer, simulating a capsule, is noticeable in the stratum Malpighii in chronic inflammation of the skin, in the regeneration of the epidermis, and in other stratified epithelium under normal and abnormal states. Whether or not this condition stands in definite relation to the normal structure of some cells recently described by F. Heidenhain, it is not possible to say; Heidenhain's observations, however, as to the normal differentiation of the cell protoplasm into zones is very suggestive as offering an explanation of the above change.

As regards the separation from, or rather enclosure within, the cell substance of small and large particles (with or without vacuoles, or clear space, surrounding them), and which particles may or may not stain in the same way as the main body of the cell, it is difficult to say whether these particles are merely parts of the original cell substance more or less chemically modified, or are deposits in the cell body, *i.e.*, products of chemical changes in the cell body. At any rate two things can be asserted with confidence: (1) that these particles are to be met in a variety of conditions that have nothing to do with cancer, and (2) that, as a matter of fact, many epithelial and other cells in the course of their activities, contain or produce granules of the most varied chemical nature. Thus, the superficial cells of the stratum Malpighii produce eleidin or keratin granules; many gland cells (salivary, pancreas, and peptic cells) deposit zymogen granules; and various leucocytes produce large and small granules (eosinophile, basophile, and amphophile granules,

&c.). F. Heidenhain has shown what remarkable appearances certain cells exhibit in the matter of particles in their cell substance staining differently from the nucleus and from the rest of the cell substance; appearances which put in the shade those described by the various authors as due to differently stained "spores" within the substance of some of their cancer cells. All these facts have to be carefully considered when undertaking to investigate the morphology of epithelial and other cells; to merely describe changes, of the sort I have noted, in the substance of cancer epithelial cells as due to the presence of psorosperms or of their spores, is a proceeding which is either due to inexperience and to a want of knowledge of elementary histological facts, or to a want of appreciation of what constitutes trustworthy evidence.

A third obstacle to acceptance of the parasitic theory of cancer is the normal horny change of epithelial cells. This has been entirely overlooked by some of the most prominent cancer parasitologists. Nucleated horny kerato-hyaline cells are undoubtedly present in the superficial layers of cancers occurring in connexion with the skin and the oral cavity. But in hypertrophied epithelium such as occurs in various processes associated with chronic inflammations of the skin or of the mucous membrane of the oral cavity, there are always found amongst the superficial layers of the stratified epithelium, certain cells which become conspicuous in sections stained first with rubin or fuchsin and afterwards with methyl blue. These cells contain a keratinous hyaline body, and a small shrunken nucleus; the former is transparent, but stained bright pink, the latter uniformly of deep blue colour. Even in sections stained with gentian violet, these cells are conspicuous by their deeply and uniformly stained small nucleus, and by their pale, purple, homogeneous cell body. In some sections such cells are so conspicuous that they stand out prominently, and I presume, for this reason, have been assumed as something foreign in cancer. But a careful examination shows that they are unmistakeably epithelial cells which have undergone keratinous change. In sections through the superficial layer of the epidermis of sheep-pox, in similar sections of the vesicles of vaccinia and of cowpox, in the epithelium covering the lips, palate, and tongue, in foot-and-mouth disease, and in the nipple in inflammatory processes of the mammæ, these appearances are found as numerously as in cancer; and there is no difficulty in tracing their relation in the above-named diseases to keratinous cells, such as normally constitute the stratum lucidum or the superficial layer of the oral epithelium. In the sections, the keratinous parts of the cell are stained deep pink (by rubin or fuchsin), while the small, shrunken, homogeneous nucleus takes the methyl blue very readily. Various authors have, indeed, described and correctly interpreted these kerato-hyaline cells; but there are nevertheless others who, with Darrier, still consider them as parasites.

And, finally, there is obstacle to acceptance of the dictum which alleges the presence of spores in the nucleus of the cancer epithelial cell. Ruffer, "British Medical Journal," 1892, and others, notably Soudakewitsch, describe the growth and presence of numerous granules (spores of the parasite, they say) within the nucleus of the cancer epithelial cell. But in their description no valid grounds are afforded for differentiating these intranuclear bodies from changes in the nuclear chromatin. In fact, all these morphological changes may well be due, and probably are due, to the breaking down of the intranuclear chromatin; and it is particularly with reference to the changes of this latter substance in epithelial nuclei under various conditions, normal and pathological, that these statements of Ruffer and of other

observers are extremely deficient. These, and similar phenomena, may or may not be due to the presence of spores; but before anything definite can be affirmed of them in this sense, the chromatin changes of nuclei under similar conditions of cell multiplication and cell destruction, require careful study. Such study, so far as I can see, has not yet been carried out.

From the various considerations I have adduced, it must be evident that a number of assertions as to the parasitic nature, in cancer, of various bodies in the substance of the epithelial cells, of nuclear-like bodies between the epithelial cells, of encysted nucleated bodies, of hyaline nucleated cells, of multi-nucleated cells within epithelial cells, and of stained particles within the epithelial nuclei, take no account of the presence of similar bodies and of similar change in epithelium that is not cancerous; and until such comparative study of the epithelium in health and in disease has been undertaken, statements to the above effect cannot claim that value which their authors attribute to them.

But I have not completely exhausted the list of difficulties which beset a theory of parasitic cause for cancer. Not least among those that remain is the circumstance that few observers describe the same kind of parasite. One might almost say that there seem to be as many kinds of cancer parasite as there are writers thereon; and, further, that the morphological characters of most of these alleged parasites do not conform with the characters of any of the known psorosperm species.

A notable exception is however to be made in the case of L. Pfeiffer. His numerous researches* testify not only to his thorough and extensive knowledge of the subject of undoubted parasitism of sporidia in the animal kingdom, but also in a very high degree to his systematic investigations of the characters and occurrence of these and similar bodies. Whatever, therefore, he has to say on this subject should command universal and respectful attention. We may differ from him, and may hold that his generalisations, notably with reference to the same kind of parasitism in variola, vaccinia, varicella, herpes, variola ovina, and in other vesicular diseases, are by no means satisfactorily established by the evidence he adduces; nevertheless he makes a genuine scientific and systematised attempt at throwing light on what is shrouded in darkness, and what is considerably complicated by the many less extensive investigations and somewhat hasty assertions of a great number of young pathologists.

Omitting, as outside the scope of this critical review, Pfeiffer's studies of the nature, character, and distribution of coccidia, klossia, and eimeria, and of the sporidia (myxo, sarco, and micro-sporidia), I turn to his observations on amœbo-sporidia in cancer in the human subject. According to him the parasite of cancer is found either within the epithelial cells in the form of an intracellular encysted spore, or around the epithelial cells as a free and growing cell-like germ which, when enlarging, resembles a nucleated protoplasmic cell; such cells as are always found numerously infiltrating the connective tissue around the true cancer epithelial masses. That is to say, Pfeiffer considers the various intracellular bodies as spores, and the leucocytes infiltrating the connective tissue as the growing cancer parasites. Views of this kind, which, on the one hand, cannot be

* "Die Protozoen als Krankheitserreger" Jena 1890, "Untersuchungen uber den Krebs," Jena 1893, and "Der Parasitismus des Epithelcarcinoms," "Centralblatt f. Bakt und Parasitenk," vol. xiv., page 118.

accepted as based on anything like evidence, but rather as a sort of *ipse dixit*, cannot, on the other hand, be directly disposed of. In just the same way it is open to anyone to affirm that the white blood cells found in inflammation, &c., are amœbo-sporidia, though other persons may prefer to call them inflammatory cells, exudation cells, or leucocytes. They all are, whatever we call them, living independent organisms which grow and multiply. If it be contended that they, being normal constituents of the healthy body, cannot be the parasites of cancer, it might be answered that the amœbo-sporidia of Pfeiffer's are not identical with them; that the normal white blood cells are one species, and that the amœbo-sporidia are a different pathogenic species. I am merely showing the kind of argument that Pfeiffer could bring forward if he chose to go beyond his *ipse dixit*. And nothing is gained by studying Pfeiffer's photograms (l c., Plate 1, Figures 1–4), representing sections through epithelial cancer of the pectoral muscle and the lip of man, which are submitted by him as illustrating amœbo-sporidia. What is represented by him under a low magnifying power ($\times$ 60) may be anything; whereas the appearances shown (Figure 4) under a magnifying power of 600, are nothing else than a cluster of nuclei, which may be those of epithelial cells or of leucocytes.

Pfeiffer's researches, indeed, though systematic and exhaustive so far as they refer to the nature and distribution of coccidia and allied psorosperms, and to the various sporidia in the animal kingdom, are extremely fragmentary with reference to cancer in man; there is practically no satisfactory evidence of the presence of what Pfeiffer calls spore forms in the cancer epithelial cells, or of the presence of amœba forms around them.

One of the most striking facts in the large mass of the literature on the subject of coccidia and psorosperms in cancer, is the absence of any well authenticated sickle-like bodies; that is to say, of those characteristic bodies which, according to the unanimous testimony of all those who have investigated the life history of the various parasitic and non-parasitic coccidia and psorosperms (Leukart, Bütschli, Eimer, L. Pfeiffer, and others), constitute one of the most typical phases in the life cycle of a coccidium—the phase, namely, of commencing germination of the spores. True, there have been a few observers (Soudakewitsch, for instance), who assert the occurrence in cancer of sickle-like bodies, but most other observers deny their relation to cancer, and regard them as altered nuclei. There is no difficulty, whatever, in finding in cancer, as also in other chronically and acutely changed epithelium, nuclei of the epithelial cells which resemble, or rather possess the shape of, crescentic or sickle-like bodies; nuclei, that is, which are so changed that they appear swollen or hydropic, with their chromatin collected at one side in the form of a crescentic body. So that the only typical phase, *i.e.*, sickle-like germs, of a coccidium or psorosperm, the constancy of which would represent a certain morphological evidence for the presence of coccidia or of psorosperms in cancer, is absent. As a consequence, therefore, the acceptance of other phases of the alleged coccidia in cancer constantly met with in the writings of parasitologists is beset with very grave difficulties.

Briefly reviewed the following are the conditions which have been described as indicating psorosperms or zoospores in cancer:—

1. There is, in the first place, the occurrence of encysted nucleated protoplasmic bodies amongst the epithelial cells of cancer, which resemble, to a limited extent, similar bodies in, for instance, the coccidia in the rabbit's liver. With reference to these encysted cells it has to be

said that such forms do undoubtedly occur in cancer. I have examined a considerable number of sections through cancer—of the lip, and tongue, of the penis, of the liver, of the omentum, of the breast, of the bladder, and of the œsophagus—and have met with such encysted cells. But I have met the same bodies in stratified epithelium of a variety of tissues in normal, and particularly in pathological, conditions which have nothing to do with cancer. Hence I am justified in denying their parasitic nature, not only because they occur in normal stratified epithelium, but also, and chiefly, from the fact that in every respect they resemble epithelial cells wherein the main body of the protoplasm has shrunk around the nucleus, leaving a peripheral portion surrounding it like a capsule. Whether this apparent encysting of nucleated epithelial cells is connected with and dependent on the structural differences of the marginal and central portions of the cell protoplasm, as is suggested by Heidenhain's researches, I am unable to say; but as evidence at least tending in this direction, I may state that, however partial or extensive coagulation-necrosis occurs in stratified epithelium, such apparent encysting of the main coagulated mass of the epithelial substance does occur. To this class of appearances belong epithelial cells in which the nucleus is shifted to one side and compressed, owing to the presence within the central part of the cell of an almost homogeneous spherical body; and in this remnants of granular matter may be often recognised. These clear intracellular globules are represented by some observers as the cancer parasites; but apart from their remarkable dissimilarity to anything resembling a sporozoon, the possibility of their being indicative of and due to a hydropic or colloid change of the cell protoplasm must not be lost sight of. Moreover, the presence of fluid colloid fatty matter or other material within the cell protoplasm, is not at all of rare occurrence in epithelial and other cells in various pathological states.

2. The presence of well-outlined, more or less clear, intracellular bodies showing a more or less distinct peripheral radial striation with a central deeply stained granule or granules (Soudakewitsch, Ruffer). These strikingly resemble altered nuclei of the epithelial cells: that is, in a hydropic condition with accumulation in the centre of the main part of the chromatin, remnants of the mitoma still attaching the chromatin to the nuclear membrane. I do not miss these forms in cancer, in fact they are by many considered to be the most characteristic forms. But in some cancers that I have examined they are not numerous; and I do not see that the evidence as to their parasitic nature is at all satisfactory, the less since bodies closely resembling such forms are to be met with in epithelial structures under other conditions, as already stated. It is quite possible that in cancer the changes of the nuclei in epithelium are of a chemical nature different from those obtaining in other conditions, and that hence they are more easily met with in cancer than in other diseases; but this is no reason why such changes should be considered as indicating the presence of parasites. In passing, it may be mentioned that these bodies do not occur in the coccidia, say, of the rabbit's liver.

3. The presence of "spores" and "spore-like" bodies in the cell substance and in the nuclei of the epithelial cells in cancer, either isolated or in groups. To these, Sjöbring, Soudakewitsch, Ruffer, and Walker have devoted particular attention; and they undoubtedly represent good types of the so-called cancer parasites which can be easily studied. But, as I have stated, such "spores" cannot be distinguished from masses of cell protoplasm or of nuclear substance respectively, separated

from the main cell substance, and owing to chemical change taking dyes often differently. Besides such spore-like bodies are met with in epithelium under conditions (sheep-pox, foot-and-mouth disease, chronic inflammation of skin, &c.) that have nothing whatever to do with cancer. It must, however, be left open whether this interpretation is or is not a correct one; though amongst the figures given by the different observers as showing intracellular spores (Sjöbring, Ruffer, and Walker) there are some that cannot be distinguished from vacuoles in the protoplasms of epithelial cells.

4. As to the presence of rounded transparent cells with one, two, or more nuclei amongst, or even within, the epithelial cells, there is nothing to distinguish them from ordinary leucocytes. They are met with in cancer, and they are met with in the normal epithelium of the palate, tonsil, and back of the tongue. To assume with L. Pfeiffer that these are amœbosporidia seems quite gratuitous. The same applies to the kerato-hyaline cells already mentioned, and which are said to be a phase of the cancer coccidium.

5. Perhaps the most important bodies that have been adduced as cancer parasites have not yet been mentioned by me. They are those described by Korotneff in "Centralblatt f. Bakt und Parasitenk," vol. xiii., p. 373. Under the name of *rophalocephalus carcinomatosus*, Korotneff describes a pedunculated and band-like protoplasmic mass, consisting of a spheroidal or pear-shaped nucleated "head," and, directly continued from it, a band-like longer or shorter protoplasmic mass. The whole is without a sheath and is situated partly within and partly without the epithelial cells of a cancer; and the band-like stalk is several times the diameter of the individual epithelial cells. In this form the "parasite" is considered as an adult one, whereas smaller uni, duo, or pluri-nucleated masses without stalks are considered young or growing forms—gregarina forms. This parasite was found not only in carcinoma labii but also in carcinoma mammæ, maxillæ, &c. Kurloff in "Centralblatt f. Bakt und Parasit," vol. xv., p. 341, adduces confirmatory evidence as to the existence of these forms: namely, adult band-like masses with a nucleated head, and also smaller spherical, oval or pear-shaped masses (*i.e.*, growing forms) in a case of carcinoma of the skin of the hand.

These band-like masses with nucleated pear-shaped head, are from their shape and their size so unlike anything else amongst the epithelium that it is quite out of the question to refer them to anything belonging to the epithelial or to other known cells, and the question therefore arises as to their nature and as to their relation to carcinoma. Both Korotneff and Kurloff show that by special staining they can be easily demonstrated; and in this I agree, so far as their presence in some carcinomata is concerned. I have seen identical bodies in sections of a carcinoma of the œsophagus, which were stained first in fuchsin or rubin and then in methyl blue. They were conspicuous not only by their shape but also by their deep pink stain (fuchsin or rubin) which they take up and retain with great persistence. They appeared as partly intracellular, more generally intercellular, filamentous, or band-like deeply stained masses with a spheroidal or pear-shaped nucleated enlargement; and in this form they are easily recognised. Besides such forms there occur similar deep-pink spheroidal or oval nucleated intracellular masses; and it is difficult to decide whether all these or only some of them, notably the larger ones, are merely truncated enlargements of the former. The smaller of such forms are, most probably, young growing forms, as is maintained by Korotneff and Kurloff; but it must be obvious that the "rophalocephalus" may appear

in the specimen in longitudinal, in oblique, or in transverse section, and as a matter of fact gradations between the long band-like and so-called forms and the spherical or oval nucleated bodies, can be easily observed. I myself cannot say whether the smaller uni, bi, or multi-nucleated intracellular corpuscles referred to by these authors are in reality what they appear to be, namely, young and growing forms; or whether they are merely the "heads" of the band-like forms seen in optical or in real transverse section. If the former view, viz., that of Korotneff and Kurloff, be the right one, some of these young amœba-like nucleated bodies (gregariniform) have been described by other observers, notably by Sawtschenko and Ruffer.

It may not be amiss to mention here that it seems to me that some, at any rate, of the "fuchsin bodies" first described by Russell, "British Medical Journal," 1891, belong to this category; and it may also be mentioned that others of Russell's fuchsin bodies are red blood corpuscles, for in some carcinomata red blood corpuscles deeply stained with fuchsin can be found between the deep epithelial cells. That they are red blood corpuscles can be recognised by their size and shape, and by the fact that the capillaries of the papillæ contain them. But some of the larger "fuchsin bodies" of Russell seem to me to be undoubtedly the above parasite-like bodies.

There can be then no doubt that there occur in cancer certain bodies which can be distinguished as separate and different from epithelial cells, from nuclei, or from leucocytes; and the question is, Of what nature are they? The two Russian authors consider some of them as rophalocephalus carcinomatosus in its adult stage, while the smaller nucleated bodies they consider as young growing gregarinous forms. It seems to me, however, that it is not necessary to accept this view of a new species, one which by the way does not coincide in its characters with any known gregarinæ. It appears more probable that the band-like pedunculated knobbed nucleated mass of protoplasm represents simply a large amœba that has thrown out a long stalk, and that when the amœba, after the nature of amœbæ, divides it gives origin to smaller nucleated protoplasmic masses. If only the latter were present in the sections, it would, owing to their special staining and their intracellular position, not be difficult to mistake them for epithelial cells or leucocytes; but the presence of the large pedunculated knobbed masses are of the utmost importance as proving that we are dealing with something quite different from either epithelial cells or leucocytes.

I have searched for these pedunculated amœbæ in a large number of carcinomata; but, excepting in a single case of carcinoma of the œsophagus, I have not come across them. As already stated, however, Korotneff has in this respect been more fortunate.

To sum up, then, we have to exclude from the evidence adduced by the various authors, as indicating cancer parasites, the following bodies:—

(*a*.) Nucleated epithelial cells which have undergone a kerato-hyaline change. These are observable as spheroidal or oval corpuscles, generally situated away from the deepest epithelial cells; that is, from the cells immediately in contact with the connective tissue matrix. They are of about the size of ordinary epithelial cells, stain like keratin of the superficial cells, and possess a relatively small deeply stained shrunken nucleus, such as is found in many other examples of chemically or acutely inflamed epithelium.

(*b*.) Spherical transparent cells with one, two, or more nuclei, which in aspect, size, nuclei, and in their mode of staining, cannot be dis-

tinguished from ordinary leucocytes. They are found between the epithelial cells, or have immigrated into the substance of the latter—as in the case of vacuolated epithelial cells enclosing leucocytes. This appearance is found, not only in the epithelium of cancer but in many other normal or pathological conditions of epithelium. There is nothing to distinguish these small bodies from leucocytes.

(*c.*) Small and large particles, vacuoles singly and in clusters, situated in a more or less distinct cavity in the cell substance. They occur singly or several together in an epithelial cell; but similar cell enclosures occur in many other epithelial structures besides those of cancer, and the fact that they occasionally stain differently from the main cell substance may merely indicate a chemical change which this part of the cell substance has undergone: it is not a proof of their being spores of parasites.

(*d.*) Encysted nucleated epithelial cells. These are not uncommon in cancer epithelium, but they also occur in other epithelial structures. The envelope is not a real capsule, but owes its origin to a separation and shrinkage of the main part of the protoplasm around the nucleus, whereby a peripheral part remains detached and resembles a capsule. Further, in epithelial cells in which the central part has undergone a hyaline change (hydrops, colloid), the nucleus of the epithelial cells is pressed to the side.

(*e.*) Nuclear well-defined bodies, containing one or even several small granules, with, in the periphery next to the surrounding membrane, a more or less distinct radial striation. These bodies are nuclei of epithelial cells, the epithelial cell substance having become destroyed and the nucleus become swollen and hydropic. The granules and striæ are remnants of chromatin. Such bodies occur not only amongst the epithelial cells of cancer, but also in other rapidly growing epithelium.

(*f.*) Nuclear bodies situated within the epithelial cell next to the normal nucleus; the latter slightly swollen and staining differently from the former. Such occur in many epithelial and other cells—as para-nuclei—both in normal and in pathological conditions. These secondary "nuclei" are probably derivatives of the chemically changed chromatin substance of the original nucleus.

All that, therefore, remains and cannot be placed to the account of either epithelial cells or their nuclei, or of leucocytes, are the large pedunculated protoplasmic bodies with a nucleated knobbed enlargement, contained within epithelial cells, that were first seen and described by Korotneff, as rhophalocephalus carcinomatosus. These seem to me to be large amœbæ-like bodies, which, by reproduction, bring forth small nucleated protoplasmic amœbæ, generally also contained within epithelial cells. Such small amœbic offspring, just like the parent amœba, are conspicuous by their staining, and by their apparent direct connexion with the pedunculated large amœbæ. Whether many of the nucleated cells enclosed within the epithelial cells of cancer, seen and described by other observers (Soudakewitsch, Ruffer, and others) as conspicuous by their staining, are or are not the young amœbæ in question, cannot be easily determined.

Lastly, it has to be mentioned that the above pedunculated amœbæ have been found by myself in one case only, that of cancer of the œsophagus; I could not find them in many other cancers. Korotneff, however, asserts that he has found them in a variety of cancers. It is quite possible that this condition, viz., that of the pedunculated form, may be more difficult to meet with, or may be more rare; the form of smaller, rapidly dividing amœbæ being more frequent. But at all events even these

latter forms are in many cancerous epithelial growths only sparingly to be met with, in some I have missed them altogether, while in others several sections had to be examined in order to find one or the other nucleated bodies resembling them. From this it would appear hazardous to assign to them a definite causative relation to the rapid growth and multiplication of the epithelial cells constituting carcinoma.

No. 4.

Further Report on the Etiology of Vaccinia; by Dr. Klein, F.R.S.

In my last report, 1892–93, on the Etiology of Vaccinia, I stated my experience as to the paucity of bacteria in vaccine lymph, whether from the calf or from the human subject, taken under due precautions at that stage in which it is commonly used for vaccination purposes. Thus, I recorded the fact that if—in the case of human vaccinia on the 8th day, of the calf on the 5th or 6th day—the superficial layer of the vesicle be thoroughly cleansed and removed, and the lymph thereafter oozing from the pock be collected in sterile glass capillary tubes, inoculation of the lymph thus obtained into various nutritive media* only exceptionally results in growth therein of any micro-organisms. Further, I noted that the like was true of small-pox lymph, collected in a clear state at a not too forward stage of the small-pox vesicle. And I went on to infer that the cocci, bacilli, yeasts, &c., which have by so many observers been grown in culture from vaccine lymph, are by no means essential constituents of the lymph; that, on the contrary, they are of extraneous origin, having been derived in all probability from the superficial crust, or added to the lymph from other outside sources during the process of collection.

In the report in question I also pointed out that short bacilli are present in suitably stained cover-glass specimens of lymph taken from the pock of the calf at an interval at 72 to 96 hours after vaccination. In some specimens of early lymph these bacilli occur in very great numbers, in later lymph their number is not so large; and I have surmised that their scarcity in late lymph is probably due to the disappearance of the bacillary substance of the microbe in sequence to its formation of spores. Illustrations appended to my report displayed these bacilli in early lymph in pure culture. In addition, I showed that in human vaccine lymph on the 8th day of the vesicle, as also in the clear lymph of human small-pox at 3rd and 4th days of the eruption, similar small bacilli could be recognised; and that, invariably, these bacilli refused to grow in artificial culture on or in any of the media used by me to that end.

Two publications have since appeared which deal with this subject:—

(1.) Besser: Centralbl. f. Bakt. und Parasis., Vol. XIII., p. 590: finds in the lymph of human small-pox a small bacillus corresponding morphologically to that described and figured by myself; but which, unlike my small-pox bacillus, is capable of being grown on the ordinary culture media. For this reason I do not consider this observer's positive result as free from doubt; indeed I feel certain that the bacillus cultivated by Besser is not identical with that which I found in small-pox lymph.

* The media experimented with were:—ordinary nutritive agar, glycerine agar, and blood serum in fluid and in solid condition.

(2.) The second publication referred to is by Dr. Buttersack. It appeared first in the "Deutsche Med. Wochenschrift 1893," No. 51, and was afterwards published in full in the "Arbeiten aus dem Kaiserl. Gesundheitsamte," vol. ix., part i., p. 96. This observer finds in vaccine lymph, dried on cover-glasses, a dense network of threads with which are associated a number of granules; and he concludes that these features are peculiar to vaccine lymph, since he finds them in no other exudation fluid of the skin. Further, he considers the threads as the growing vegetative part of a vaccine fungus, and the granules he regards as spores of the same. To those acquainted with the various classical publications that have come out in the Kaiserl. Gesundheitsamte,* the appearance of Dr. Buttersack's paper therein must have caused surprise; and not least, in view of the method by which he achieves his results, viz., by drying of a thin film of lymph on a cover-glass, and then (sometimes) staining it in suitable dyes. Although a host of competent workers have worked in the same direction—Koch and his colleagues at the Kais. Gesundheitsamte amongst them, and be it noted by exactly the same method that Buttersack describes as a new method—not one has ever mistaken threads and granules of fibrin, or of some other albuminous substance, for a mycelium with spores. The features described by Buttersack are, he admits, not always present; and the reason he assigns for other observers having missed them (viz., that they are not visible in the fresh state but only after drying) is on the face of it altogether insufficient. Though I do not doubt that in his dried specimens of lymph Buttersack found all the features that he describes, there is not the smallest reason for accepting them as indicating the presence of a micro-organism, or for crediting that they were discovered by him as the result of a new method.

During 1893–94 I have further attempted to cultivate vaccine lymph, seeking thereby demonstration that the bacilli found by me in the lymph of the early vaccine vesicle of the calf are actually living organisms. For this purpose two methods have been employed:—

(1.) *Direct cultivation.*—As in last year's experiments, lymph was collected from successful insertions in calf pox; the vaccine lymph being taken from calves in usé at Lamb's Conduit Street for the vaccination of calves and infants. In each instance it was proved to be active lymph in the routine processes of that Establishment. Before taking the lymph the surface of the pock was well cleaned, and the superficial layer removed with a sterile scalpel; then, the pock having been clamped between sterile vaccine forceps, the clear lymph oozing out was allowed to run into freshly drawn out capillary glass pipettes. From these pipettes, inoculations were made of different culture tubes. As culture material I used:—

(*a.*) Ordinary nutritive agar, solid.
(*b.*) Glycerine agar, solid.
(*c.*) Fluid horse-serum.
(*d.*) Solid horse-serum.

* Koch's papers on Anthrax, on Disinfection, and on Tuberculosis; Gaffky's papers on Typhoid Fever; Löffler's papers on Diphtheria and on Glanders; Schutz' papers on Glanders, Swine Erysipelas, &c.; Hueppe's paper on Milk fermentation; Hesse's paper on Air Organisms; and a host of other most accurate papers on various bacteriological subjects, all of them marked by precision of method, trustworthiness as to fact, and care in drawing conclusions.

Serum of the horse was chosen since it can easily (more easily than ox's serum) be obtained in large quantities in a clear state, and on account also of the horse being an animal susceptible to cow-pox.

Each culture tube received a drop of the vaccine lymph, which in the case of the solid media was rubbed over the surface with a sterile platinum loop. The tubes were next all "capped" so as to avoid loss of fluid and drying up, and were incubated at 37° C. I have thus made cultivations :—

(1.) In one instance of 72 hours' lymph.
(2.) In one instance of 68 hours' lymph.
(3.) In four instances of 96 hours' lymph ; and
(4.) In two instances of 100 to 112 hours' lymph.

In each series, that is to say from each actual sample of lymph, there were made—

(*a.*) Three cultures on ordinary agar.
(*b.*) Three cultures on glycerine agar.
(*c.*) Three cultures in fluid horse-serum, and
(*d.*) Six cultures on solid horse-serum.

The cultures were kept under observation for over three weeks, but in not one single tube was there any growth obtained: they all remained sterile. We have then here a considerable number of cultivations, and yet not one showed any growth. This result coincides with last year's (1892–93),observations, and with those recorded by other observers.

(2.) *Indirect cultivation.*—In the course of other studies I had observed that on inoculating, subcutaneously in the groin, guinea pigs with vaccine lymph, the inguinal glands of the inoculated side could on the fourth and fifth days be distinctly felt as slightly enlarged. On the sixth and seventh days this enlargement was a little more marked, and afterwards it gradually subsided. Hence I thought it possible that this enlargement, appearing as it did after lapse of three days, might be due to the growth and multiplication in the guinea pigs' tissue of an organism ; possibly the vaccine organism. I therefore—

(*a.*) Inoculated two guinea pigs *subcutaneously* in the groin with a few drops of active (sixth-day) calf vaccine lymph. The animals were killed on the eighth day ; when the inguinal glands of the inoculated side were found slightly enlarged, and the connective tissue around them infiltrated with sanguineous matter. These glands were then cleared of all their surrounding tissue, and, an incision having been made into them, disc-shaped particles (each about the eighth of an inch in diameter) of the gland tissue (which was rather juicy) were cut out with sterile scissors for transference to culture tubes. With each particle, two agar, two glycerine agar, and two solid horse-serum tubes were inoculated, by rubbing the particle well over the slanting surface. The tubes were then capped and placed in the incubator at 37° C. Altogether from each guinea pig, 12 culture tubes were inoculated. The tubes were inspected from day to day for four weeks ; but not a single one of them showed any growth ; they all remained sterile.

(*b.*) Two calves were next inoculated *subcutaneously* in the groin with a few drops of active calf vaccine lymph, each animal receiving the contents of three ordinary calf vaccine tubes. The inguinal glands of these calves on the inoculated side, were then watched from day to day.

On the sixth and seventh days they were for the first time to be just felt; on the eighth day they were distinctly enlarged. At this date they were cut out, and cultures were made with their tissue on agar and on serum; but these media remained perfectly sterile, no growth of any kind appearing in them.

No. 5.

Preliminary Report on the Chemical Pathology of acute Traumatic Tetanus; by Sidney Martin, M.D., F.R.C.P.

I have in my previous reports on Anthrax, on Infective Endocarditis, and on Diphtheria shown that the poisonous chemical substances found in the blood and tissues in these acute infective disorders, belong to two classes; and that these poisons are in each instance formed by the transformation of the proteid substances present in the body, *i.e.*, by a process of digestion.

The poisons of the two classes are:—

1. The digested proteids; albumoses.
2. The final products, some of which are acid bodies and some basic.

As regards the physiological action of the albumoses, in the three diseases so far examined they are fever producers, and moreover possess a special action (in rabbits) on the heart, whereby the cardiac muscle undergoes fatty degeneration, the skeletal muscles being unaffected. The diphtheria albumoses have, however, a further and special action in that they produce a paralysis due to a degeneration of the peripheral nerves, sensory and motor; while in large doses they act on the spinal cord as a paralysing agent. The final products, in infective endocarditis and in diphtheria, are acid bodies, and they possess only a feeble toxic action. But in anthrax the final product is a basic body which produces coma and is the chief agent by which death is caused. The final products are not, like the albumoses, to any great extent, if at all, fever producers.

The Chemical Pathology of Tetanus.

In my study of the chemical pathology of tetanus, I have proceeded in a manner similar to that observed in my investigation of Diphtheria, viz., by making, first of all, a chemical examination of the tissues of patients dead of the disease. In the present report I confine myself to the results obtained in this sense, reserving the examination of the chemical substances produced by the bacillus of tetanus in artificial culture for a future report.

Acute traumatic tetanus is a disease in which, following a wound or injury, there arises a series of symptoms which are quite characteristic, viz., fever and recurring convulsions.

The wound may be a penetrating one, and may contain a foreign body visible to the naked eye, such as a splinter of wood; or the injury may be a compound fracture of a limb, or even a mere abrasion. In some instances no wound is discoverable.

The wound is the seat of inoculation of the disease, and its examination chemically presents great difficulties. In cases where it is simply an abrasion which has already been treated surgically, no chemical examination would be of service. In one such case I have tested the infectivity of the wound by inoculating material from it into rodents; but no effect was produced. In cases of tetanus following a penetrating wound, from which there is found exuding a small quantity of ichorous pus, the infectivity of the wound has been tested by various observers; but I have not been fortunate enough to obtain sufficient of this pus for chemical examination. The study of the chemical pathology of tetanus is somewhat hampered by these difficulties, inasmuch as it is possible

that the examination of the local lesion would, if practicable, yield as interesting results as in the case of the diphtheritic membrane.

Subsequent to infliction of the wound there occurs, in tetanus, a period of incubation, after which there is onset of spasm of the muscles, face, jaw, limb, and trunk muscles, along with a rise in body temperature. The recurring spasms need no description here; they are slight at first and become more intense, lasting till death. The fever lasts throughout the illness; it may rise higher, or may fall, just before death.

The higher cerebral centres are not affected, and the chief influence of the poison is exerted on the motor nerve cells.

One other symptom is frequently noticed, more especially towards the end of the disease, viz., increased rapidity of the cardiac beat, indicating cardiac failure. This symptom may partly be ascribed to the severity of the muscular spasms; but not wholly, since cardiac failure in an infective disease is one of the effects of the action of the poisons producing it.

The tissues of the body that I selected for examination in tetanus were the blood, the spleen, and the spinal cord. The blood must, if there be a chemical poison peculiar to this disease, be the means of its transmission through the body. The spleen was selected for examination owing to the fact that in diphtheria, where this organ is not enlarged, it is the chief repository of the chemical poisons that characterise that malady; and it was thought that a similar condition of things might exist in tetanus. The spinal cord was examined chemically, for the reason that in tetanus the poison appears to select the motor nerve cells for its specific action, just as strychnine does; and it seemed, therefore, quite possible, indeed probable, that part of the tetanic poison might after death be present in the spinal cord.

Cases of Tetanus examined.

The cases of tetanus examined were obtained during the last three years (1891–1894) at the Middlesex, St. Thomas's, St. Mary's, Great Northern, and University College Hospitals.* They were seven in all, and they presented some variety as to their symptoms during life.

Nature of Injury.—Six of the cases showed a seat of injury at which the tetanus poison might have entered. Two were cases of compound fracture (Cases II. and VII.): in one, fracture of a metatarsal bone caused by a pickaxe, in the other, fracture of the forearm. Two were penetrating wounds of the soft tissues: in one, of the sole of the foot by a nail; in the other, of the back of the right thigh near the gluteal region, by an iron spike, a piece of the trousers being driven in (Cases I. and IV.). In two there was a superficial wound or abrasion: in one, a wound of the scalp caused by striking the head against the curb of the pavement; in the other, an abrasion of the shin of the right leg (Cases III. and V.). In one only of the seven cases was there no wound, fracture, or abrasion discoverable during life or after death (Case VI.). The man in question fell with a sack of flour on to his right side; but there was no lesion. Some acne pustules found on the chest were suggested as possible seats of inoculation, but this can only be considered as mere surmise. It is quite possible, that the infection took place in this case by way of one of the mucous membranes (the nasal, buccal, or pharyngeal), and was conveyed in the dust raised by the heavy fall of this big man with a sack of flour. The

* I wish to express my indebtedness to the kindness of Mr. A. Q. Silcock, Dr. W. Edmunds, and Dr. Galloway for sending me specimens from cases of tetanus.

case is to be regarded as one of those described as idiopathic, *i.e.*, as occurring without any open wound.

Period elapsing between the Injury and the Onset of Symptoms.—Cases of tetanus may be divided in this respect into two classes. In one the onset of symptoms occurs in the first week,—from the third to the seventh day; in the other class it is delayed to the tenth day or later. In five of the cases observed (Cases I., II., III., V., and VI.), the symptoms appeared in the first week; in one (Case VII.) on the ninth day, and in one (Case IV.) on the twelfth day.

Symptoms observed.—The symptoms observed were those seen in all severe cases of tetanus, viz., tonic and clonic spasms of the muscles; slight at first, and gradually increasing in severity up to death. Fever was present in all, and tended towards hyperpyrexia in one case (VI.) for three days before death. As to Case IV., which differed from the others in so far that the onset was delayed until the twelfth day, there was only a moderate number of spasms, and rise of temperature only during the last two days of life; death occurred from cardiac failure, which was evident during the last three days of life. In Case VII., in which the onset of tetanic spasms was delayed until the ninth day, death was sudden.

The treatment of the wound in relation to the symptoms is important. In Case I. the wound was not excised, and at death it contained a small quantity of ichorous pus. In Cases II. and IV. the wound was not excised, but was treated antiseptically. In Case V. no special treatment of the abrasion was adopted. In Case III. the scalp wound was excised immediately on admission into the hospital for tetanus, seven days after the injury. The symptoms of the disease were, however, in this case, as severe as in those with un-excised wounds, and, like them, the case ended fatally. This case is important, since it shows that in one week after the injury sufficient of the virus had entered the body from the local lesion to produce a fatal result. In Case VII., the surgical treatment of the wound was successful, and in spite of the laceration of the parts no suppuration had occurred.

The features of tetanus, which it is desired to emphasize from the point of view of this report are: the period of incubation; the gradual onset of the disease; the gradual increase in severity of the muscular spasms; the irregular fever; and the tendency to death from cardiac failure. These facts suffice to indicate that acute traumatic tetanus is an infective disorder. The gradual onset of symptoms seems to imply, too, a gradual accumulation of poison in the body.

Death occurred in five of the cases examined in from 7–10 days from the onset of tetanic symptoms: in two of the cases, in three days. The fatal result is to be ascribed, not to one cause but to several. The continued tonic and clonic spasms lead to exhaustion, and to asphyxia through affection of the muscles of respiration. The state of fever contributes also to the fatal result. The effect of the poison on the heart is one not usually recognised as a cause of death, though this is probably a factor of great importance.

The post-mortem examination of the cases examined showed no unusual features. Besides the effects of asphyxia, as shown in cyanosis of the face and extremities, in sub-serous and occasionally sub-mucous ecchymoses, and in mechanical congestion of the liver, spleen, kidneys, and intestines, due to dilatation of the right side of the heart, no change in the organs or tissues was evident of a sort to account for death. The spinal cord of the two cases in which it was examined (Cases II. and VII.) showed no naked-eye change.

The following table of the cases examined shows the main features of each case at a glance :—

Patient.	Sex and Age.	Nature and Seat of Injury.	Period elapsing between Injury and onset of Tetanic Symptoms.	Nature of Symptoms.	Period elapsing between Injury and Death.
Case I.	M. 28	Penetrating wound (1 inch deep) of the sole of left foot, caused by a nail. Some suppuration of wound.	7 days	Increasing severity of spasms during last 3 days of life.	10 days.
Case II.	M. 42	Compound fracture of first metatarsal bone of right foot, caused by blow of pickaxe.	3 days	No unusual symptoms	12 days.
Case III.	M. 12	Scalp wound, caused by striking head on curb of footpath in street.	6 days.	Continuous spasms during last 9 days of life. Excision of wound 9 days before death.	16 days.
Case IV.	M. 9	Wound of posterior part of right thigh, through sitting down on an iron spike. Piece of trowsers driven in.	12 days	Moderate number of spasms. Cardiac failure last three days of life. Fever last 2 days of life.	19 days.
Case V.	M. 43	Abrasion of skin of right shin, near tubercle of left tibia, caused while going up the ladder of a dust cart.	24 hours	Trismus. Severe spasms last 2 days of life. Gradual rise of temperature to death.	8 days.
Case VI.	M. 26	Patient stumbled while carrying a sack of flour upstairs. Fell on right side of chest. No wound or abrasion of skin. Four pustules of acne on chest.	3 days	Spasms increasing in number and severity. High fever, especially last 3 days of life. Treated with large doses of physostigma.	12 days.
Case VII.	M. (adt)	Paving stone fell on left arm. Dislocation of ulna, compound fracture of radius.	9 days.	Wound treated antiseptically. No suppuration. Some fever up to 8th day after injury; then a fall of temperature which rose again at death.	12 days.

Method of Investigation.

The method of investigation adopted was practically the same as that previously employed in the chemical examination of the tissues in diphtheria and other diseases. It is based on two principles. *First*, by treatment of the fresh tissue with alcohol until the ordinary proteids of the tissue, *e.g.*, the globulin and albumin are coagulated; so as to allow the soluble bodies, such as the albumoses and the non-proteid substances, to be extracted in a form readily manipulated. *Secondly*, employment, during the whole course of preparation of the poisonous products, of none but neutral and inactive reagents, viz., alcohol, ether, chloroform, and distilled water. It is clear that this is an important point. In the investigation of a tissue containing substances of an unknown chemical nature, it is absolutely necessary to employ reagents which are unlikely to modify them to any appreciable extent. It has been too readily assumed that the poisons present in disease, infectious disease more particularly, are of an alkaloidal nature, *i.e.*, are bases capable of combining with acids. The substances under consideration are, however, unstable, like many of the first products of the metamorphosis of

proteids. If, therefore, an acid medium be used to extract the tissues, it is quite possible that the poisonous bodies present would be decomposed, especially since the filtered acid extract has to be concentrated, thus increasing the degree of acidity. These remarks apply only to the examination of the tissues in disease the poisonous substances of which are unknown. If a base is known to be present, there is no objection to extracting it by means of solutions of mineral acids.

The exact manipulation employed may be described as follows :—

Extraction of Poisonous Bodies from the Blood and Spleen.—The tissue must remain under the alcohol until all its ordinary proteids are coagulated. This takes a varying time, but is accomplished in 2 to 3 days if a sufficiency of alcohol (short of a large excess) be used. As regards the spleen, after washing the organ, the capsule may be stripped off with forceps and the splenic pulp squeezed out with the fingers into absolute alcohol. In this way the soft pulp is separated from the fibrous tissue. If this pulp, along with the alcohol, is placed in a stoppered bottle and well shaken, the proteids are completely coagulated in 48 hours, and the process of extraction may be begun. This process is the same for all the tissues.

The alcoholic mixture thus obtained is filtered, and the yellow filtrate constitutes the alcoholic watery extract, which contains albumoses and other bodies with mineral salts. The residue on the filter is then extracted for 24 hours with distilled water, and afterwards squeezed dry through muslin and filtered. This is chiefly a watery extract. The two extracts are next mixed together and evaporated to dryness at below 40° C. *in vacuo* by means of a vacuum pump and a Liebig's condenser.

The dried residue is now treated in the evaporation flask with pure sulphuric ether, which dissolves out certain substances, leaving a copious residue. The ether and residue are poured out of the flask into a beaked glass dish, and the residue allowed to settle. This residue consists of a brown amorphous mass and of a whitish flocculent mass, both of which settle readily. The ether is poured off and filtered; it is of a yellowish colour. This is the impure *ether extract.*

The part left undissolved by the ether is now extracted with absolute alcohol until nothing more dissolves; the alcohol is poured off and filtered. This is the *alcoholic extract.*

The part remaining undissolved by the alcohol consists partly of mineral salts and partly of albumoses. In some cases, by treating this residue gently with distilled water, the albumoses enter first into solution, leaving most of the mineral salts behind. The yellow solution of albumoses thus obtained, is thrown into a large excess of absolute alcohol and precipitated.

The separation of the original extract of the tissues into an ether extract, an alcoholic extract, and albumoses, is readily performed by the above processes, which do not take more than four or five days. The crude extracts thus obtained have now to be purified.

The albumoses are readily purified. Precipitated in the form mentioned, they may have clinging to them some of the bodies soluble in ether and alcohol. These are removed in great part by allowing the albumose precipitate to stand under alcohol for a week or longer. Afterwards the alcohol is poured off, the albumose precipitate is then dissolved in a small quantity of sterile distilled water and re-precipitated by alcohol. After this second precipitate has settled (in 1–2 days) the alcohol is again poured off and the albumoses thrown on to a filter and well washed with absolute alcohol, ether, and chloroform. They are then removed from the filter by a sterile knife, placed in a glass dish and

dried *in vacuo* over sulphuric acid. This final product contains no substance soluble in alcohol, ether, or chloroform. It consists of albumoses mixed with some mineral salts. It is next to impossible to get rid of all the salts by means of this method, and dialysis of the small quantities of albumoses obtained has only resulted in losing most of the substance. The product may, however, be considered as physiologically, although not chemically, pure; for I have used the dialysed albumoses obtained from the tissues both of tetanus and of diphtheria, and found them not to differ, as regards physiological action, from the undialysed albumoses prepared by the method above described.

The ether and alcoholic extracts obtained in the manner described are divisible into two parts, *i.e.*, there is one part insoluble in ether and the other soluble; both being soluble in absolute alcohol. The ether extract is purified by evaporating off the ether at a temperature below 40° C., and treating the residue with ether and filtering; and this process is repeated until the residue is completely soluble in ether. This is the *pure ether* extract.

The alcoholic extract is purified by concentration at a temperature below 40° C. to small bulk, and by precipitation with a large excess of ether. This precipitate, which is yellowish and amorphous, is allowed to settle, and after the supernatant liquid has been poured off, is treated with alcohol, filtered, and again precipitated by ether. The process is repeated until the precipitate is completely soluble in alcohol. This is the *pure alcoholic* extract.

It is evident that this is only a commencement as regards an accurate chemical examination of these non-proteid toxic substances. But by the method described the degree of toxicity displayed by the several extracts may be judged of. I have, in investigating this series of cases of tetanus, considered each case apart, in order to determine the amount of poison present, and its relation to the fatal effect produced and to the symptoms observed during life. This is essential from the pathological point of view, but it necessarily gives in each instance such small quantities of the substances that an extended chemical investigation is impossible. In investigation of the changes brought about in infective diseases such as are now under consideration, the first thing to be determined is the toxicity of the substances separated, *i.e.*, to investigate their physiological action; after this has been done an extended chemical examination of them may be usefully undertaken.

Method of Examination of the Spinal Cord.— The spinal cord was treated in a somewhat different manner to the spleen and the blood. Obtained a few hours after death, enclosed in its membranes, it was split down the middle with a sterile knife and the substance scraped away in small masses and placed directly into a mixture of sulphuric ether and alcohol. The masses were well shaken with the liquid, which dissolved nearly all the substance, leaving shreds of the connective tissue elements of the cord and some white granular matter, which, with the ether-alcohol extract, was removed from the connective tissue by decantation. This white matter consisted of some proteids and mineral salts. The extract was evaporated to dryness, extracted with ether, and a pure ether extract obtained. The part insoluble in ether was dissolved in alcohol, filtered, and precipitated by ether. The cord was thus separated into an ether extract, an alcoholic extract and a very small amount of proteid, not albumose. This is a crude chemical manipulation of the nervous tissue of the cord, but it suffices to separate the elements with a view to testing their physiological action.

Results of the Chemical Examination of the Tissues in Tetanus.

The blood, the spleen, and the spinal cord were, as has been said, chemically examined by the methods above described.

From the blood and spleen were obtained albumoses, and acid organic bodies in the ether and alcoholic extracts.

The final state in which the *albumoses* were obtained was in the form of a light white powder, completely soluble in water, and leaving a small quantity of ash on incineration.

The watery solution of this powder was yellowish, and gave the following reactions:—

1. Nearly neutral; if anything, slightly alkaline to delicate litmus paper.
2. No precipitate as a rule with nitric acid; one specimen only (from Case I.) gave a doubtful precipitate. There was a well-marked xanthoproteic reaction.
3. A well-marked biuret reaction with a trace of copper sulphate and an excess of potash.
4. A flocculent and amorphous precipitate with neutral ammonium sulphate ($(NH_4)_2\ SO_4$), which precipitated all the proteid in solution.

These reactions show that the powder as obtained from the tissues consisted almost solely of deutero-albumose.

The ether extract is yellowish and amorphous, and not completely soluble in distilled water. The clear part of the mixture is yellow in colour and strongly acid; the insoluble part consists chiefly of fatty matter. All that can be at present said of the ether extract is that, besides fat, it contains strongly acid organic substances.

The alcoholic extract is almost completely soluble in distilled water. It is, like the ether extract, strongly acid, and is precipitated from an alcoholic solution by ether, in the form of small globules which run together into larger globules, and which dry in the form of a yellow amorphous mass.

The amount of these products obtained from the individual cases is shown in the following table:—

Tissue examined.	Amount of Products obtained, in Grammes.		
	Albumoses.	Alcoholic Extract.	Ether Extract.
Case I., blood - -	1·597	0·148	Not estimated.
Case II., spleen -	0·102	0·077	0·222
Case III. and IV., spleen	0·184	0·328	0·286
Case V., blood - -	0·124	0·341	0·140
„ spleen - -	0·268	—	0·617
Case VI., spleen -	1·930	—	—
Case VII., spleen -	0·322	Not estimated	Not estimated.

The amounts of albumoses, of alcoholic, and of ether extracts obtained from the blood and spleen of these cases of tetanus tend, as is seen from the table, to vary. But it needs to be pointed out that in all the cases

examined, the same kind of substances were obtained: always a certain quantity of albumoses, as well of the acid bodies insoluble in ether and soluble in ether. Although it cannot be said that the alcoholic and ether extracts are simple substances, yet they contain material foreign to the healthy body, and they are signs, with the presence of the albumoses, of bacterial action.

A very large quantity of albumoses was obtained from the spleen of Case VI. This was the case in which there was no external wound or other local lesion. It is quite possible that some cases of tetanus are examples of a mixed infection, at any rate in the earlier part of the illness; and it is also possible as regards the case under consideration that the infection was by way of the mucous membranes.

Physiological Action of the Substances obtained from the Blood and Spleen in Tetanus.*

The physiological action of the substances obtained from the blood and spleen in tetanus was examined in a manner similar to that adopted in the diseases I have previously investigated.

Their effect on the temperature was determined in rabbits, which are animals susceptible to the tetanus poison; and their general effects on the body were observed in both rabbits and in mice.

The precautions taken with regard to the rabbits made use of, were the same as those described in my Report on Diphtheria†; *i.e.*, the animals were isolated for some days before experiment, in order to investigate their body weight and temperature.

(*a.*) *Physiological Effect of the Albumoses obtained from the Blood and Spleen.*

The physiological action of the albumoses was tested by means of intra-venous injection of them into rabbits, in single and in multiple doses at varying intervals.

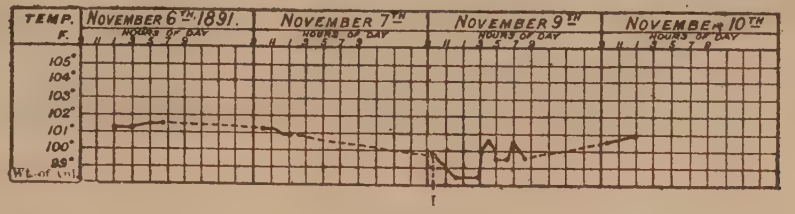
Effect of a Single Large Dose.—There was injected into the marginal vein of the ear of a rabbit weighing 1,150 grammes, 0·1645 gramme of the albumoses obtained from the blood of Case I. As shown by the subjoined chart (I.), the initial effect was a slight fall of body temperature: following this, the temperature rose to normal, but was irregular for the rest of the day. On the following day, the animal had lost 200 grammes in weight; and it continued gradually to lose weight until death on the twenty-first day of experiment, its weight at that time being only 650 grammes. Beyond the wasting there was no marked feature observed at the post-mortem examination. Cultivations were made on gelatine and agar from the blood and spleen of this animal. One agar tube inoculated with the blood showed a growth of a yellow micro-organism: the other tubes showed no growth at all. The growth in the agar tube was probably a contamination from the air. The great wasting produced in this experiment was not shown in the succeeding experiments with multiple doses of the albumoses.

* The physiological action of the substances obtained from the spinal cord will be discussed in the next report.

† Report of the Medical Officer of the Local Government Board, 1891.

Chart I.

Rabbit weighing 1,150 grammes, intra-venously injected with 0·1615 gramme of tetanus *albumoses* from *blood* of Case No. I. Dose per kilo. body weight, 0·143 gramme.—Death in 21 days. Loss of weight, 500 grammes.



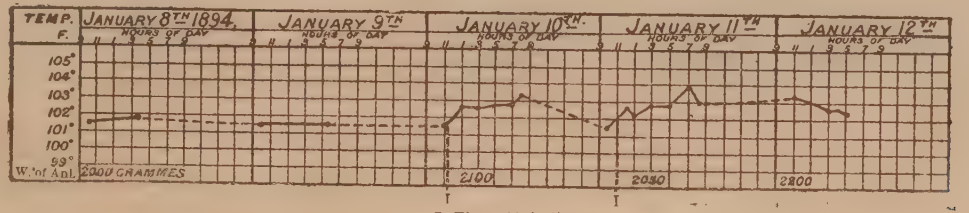
I. Time of injection.

Effect of Multiple Doses.—The three following experiments on rabbits illustrate the effect of multiple doses of the albumoses, whether obtained from the blood or spleen.

Following each injection of the albumoses, there was a rise of body temperature 2° or 3° F., and with a large total dose there was a continued rise of the body temperature for two or three days following the last injection. These results are shown in the following three charts :—

Chart II. (*a*.)

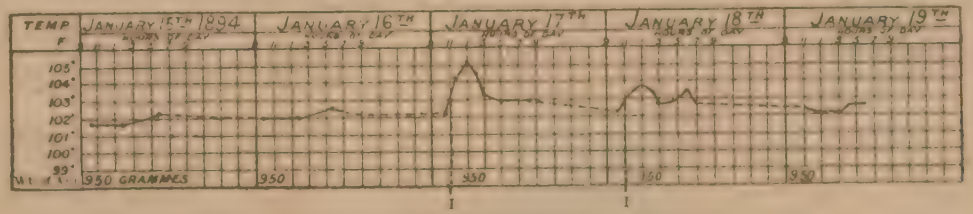
Rabbit weighing 2,100 grammes, intra-venously injected on each of two occasions with 0·062 gramme of *albumoses* from the *blood* of Case No. VII. Dose per kilo. body weight, 0·059 gramme.—No symptoms induced except slight fever. Complete recovery of rabbit, which was alive some five months later.



I. Time of injection.

CHART II. (*b*.)

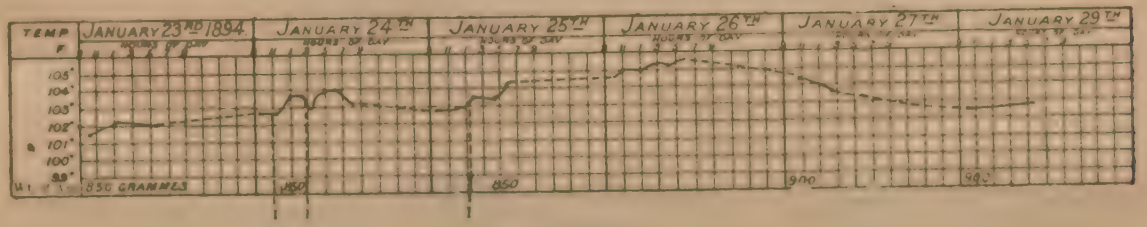
RABBIT weighing 950 grammes, intra-venously injected on each of two occasions with 0·579 gramme of *albumoses* from the *spleen* of Case No. VII. Dose per kilo. body weight, 0·16 gramme.—Rise of temperature after each injection; no other symptoms beyond loss of weight on sixth day of experiment to extent of 30 grammes, which loss was quickly regained.



I. Time of injection.

CHART II. (*c*.)

RABBIT weighing 850 grammes, intra-venously injected, twice on 24th January (0·036 gramme each time) and once (0·072 gramme) on 25th January, with *albumoses* from the *spleen* of Cases Nos. IV. and VI. Dose per kilo. body weight, 0·2 gramme.—Slight rise of temperature following two first injections, high fever after third injection, lasting three days. Animal quite well four months after experiment.



I. Time of injection.

It is noticeable that in none of these three experiments was there an appreciable loss of body weight of the animal. Indeed, beyond the degree of fever which is shown in the charts, there were no symptoms observed. There were no tonic or clonic spasms of muscles, no variation in the knee-jerks, and no diarrhœa. These results are in marked contrast to those obtained with the albumoses of diphtheria, which without fail, in multiple doses, produce wasting and a generalised paralysis. The action therefore of the tetanus albumoses is similar to that of the albumoses found in anthrax and in infective endocarditis ; viz., they are simply fever producers.

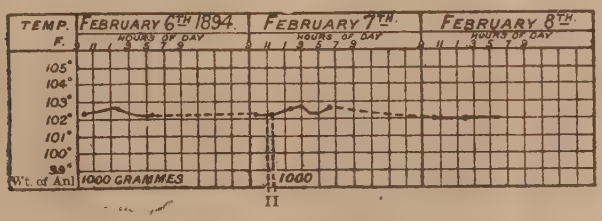
(*b.*) *Physiological Action of the Non-proteid Organic Substances separated from the Blood and Spleen.*

It has been previously stated that these bodies were divided into two classes; one insoluble in ether, and precipitated from its solution in alcohol by ether, and called the alcoholic extract, or the ether precipitate ; the other soluble in ether, but also soluble in alcohol, called the ether extract. Both these classes of substances are, as separated, strongly acid, and, pending investigation of their chemical nature, which so far has been impossible owing to the small quantities obtained, they will be referred to as the *ether precipitate* and the *ether extract*.

Action of the Ether Precipitate.—The effect on the body temperature of *rabbits* of intra-venous injection of the ether precipitate (alcoholic extract) is a very slight one. In the experiments on rabbits illustrated in the two following charts, it is seen that a dose of 0·135 gramme per kilo. of body weight caused no rise of temperature, although there was a slight rise when a much larger dose (0·3 gramme) was given; a rise, however, which is not nearly so well-marked as with a much smaller dose of the albumoses.

Chart III. (*a*.)

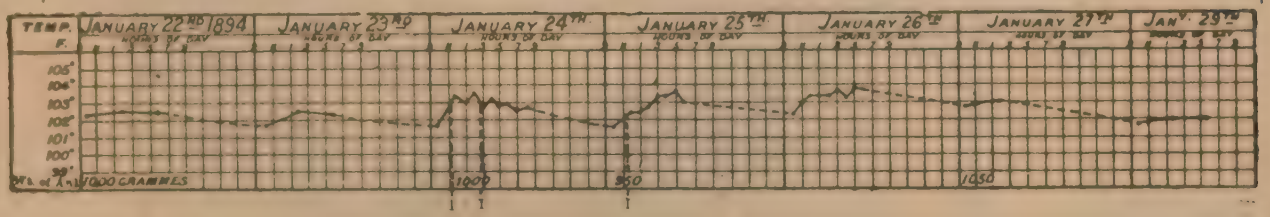
Rabbit weighing 1,000 grammes, intra-venously injected in two doses, 0·072 and 0·063 gramme respectively, with *ether precipitate* from the *blood* of Case No. VII. Dose per kilo. body weight, 0·135 gramme.—No fever or other symptoms.



I. Time of injection.

Chart III. (*b.*)

Rabbit weighing 1,000 grammes, intra-venously injected on three separate occasions, 0·09, 0·09, and 0·12 gramme respectively, with *ether precipitate* from the *spleens* of Cases Nos. IV. and VI. Dose per kilo. body weight, 0·3 gramme.—Slight rise of temperature; no other symptoms.



I. Time of injection.

The injection of the solution of the ether precipitate (almost a complete solution) produced no spasms of muscles; otherwise than in the sense above recorded the rabbits were apparently unaffected.

The general action of the ether precipitate was also tested on *mice*.

A mouse, weighing 26 grammes, received under the skin of the back 0·0124 gramme of the ether precipitate (from spleen of Case III.), dissolved in 0·1 c.c. of water. The animal was a little drowsy in two hours but showed no further symptoms; it was quite well on the next day and subsequently.

Another mouse, weighing 22 grammes, received under the skin 0·0434 gramme of the ether precipitate (from spleen of Case III.), dissolved in about 0·4 c.c. of water. This animal, like the other, became a little drowsy; but showed no other definite symptom, and completely recovered.

The physiological effect of the ether precipitate is therefore very slight; beyond a slight rise of body temperature following large doses intra-venously injected, it produces no definite symptoms. Evidently it does not contain the substance which produces the muscular spasms characteristic of tetanus.

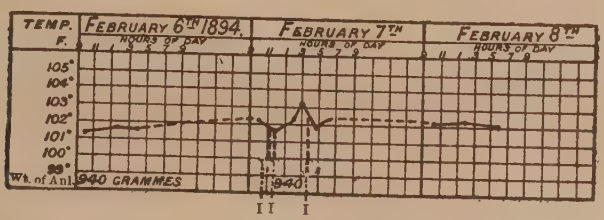
Physiological Action of the Ether Extract.—This, as previously stated, is not completely soluble in water. When treated with water it forms a turbid mixture separating into two parts, a moderate amount of yellowish amorphous matter and an opalescent yellowish and very acid fluid. It was found practically impossible to secure a clear liquid for injection, owing to the small quantities of the extract obtainable. As clear a solution as possible was obtained for intra-venous injection, in order to avoid any possible effects of embolism. Moreover, the experiments on rabbits by intra-venous injection of this extract were contrasted with the results of subcutaneous inoculations of it in mice.

The experiments with the ether extract now to be recorded I do not consider as final, since evidently an impure substance was used for these injections, namely, material containing fatty as well as acid bodies. The results are, however, significant, and serve as a basis for future investigation.

The effect on the body temperature of rabbits of the intra-venous injection of the ether extract is very slight, as shown in the accompanying chart. The ether extract in this case was prepared from the blood of Case V.

Chart IV.

Rabbit weighing 940 grammes, intra-venously injected on three separate occasions, 15, 20, and 5 minims respectively, with a turbid solution (or suspension) in water of *ether extract* from the *blood* of Case No. V. Total dose injected 0·105 gramme, equivalent to 0·11 gramme per kilo. body weight of animal.—Slight rise of temperature; no other symptoms.



I. Time of injection.

In this animal no symptoms were produced by this injection of 0·105 gramme of the extract.

In another rabbit, however, weighing 1,050 grammes, 0·143 gramme of the ether extract (from spleen of Cases III. and IV.) mixed with 10 minims of water was injected into the marginal vein of the ear, with very definite effect. The animal made a few vigorous convulsive movements with the limbs, lay still, and died in a few seconds, death being preceded by gasping. A post-mortem examination was made 40 minutes after death, and nothing abnormal was found; there was no evidence of embolism, and there was a small clot in the right ventricle.

A second experiment was performed with the same ether extract from Cases III. and IV. Thus:—

A rabbit, weighing 1,000 grammes, received intra-venously 0·0715 gramme of the ether extract mixed with 5 minims of water. No symptoms occurred in 55 minutes after the injection, so a second similar dose was given also intra-venously. The total dose was, therefore, 0·143 gramme, the same that the other animal had received. A few seconds after the second injection convulsive movements of the body appeared. There were clonic spasms of the leg; rolling movements of

the body to the right and to the left; and retraction of the head with a tendency to opisthotonos. The spasms were not continuous and were induced by pinching the foot or tail. This tetanic condition lasted about one minute, after which there was no response to stimulus. The animal was quite quiet for 15 minutes, during which time the breathing was very irregular, sometimes slow and laboured, sometimes rapid. A slight return of voluntary movement occurred in 15 minutes after the second injection, and in 20 minutes the animal could jump. In 40 minutes complete recovery had taken place; the movements of the animal were now normal, and there was no paralysis of any part. No further symptoms were noticed in this rabbit during four months.

There can be little doubt that in these two instances there was seen the effect of a poison acting on the central nervous system and producing muscular spasms, rapid elimination of the poison leading in the second case to rapid recovery.

As regards the effect of the ether extract on *mice*.—A mouse, weighing 21 grammes, received under the skin of the back 0·0444 gramme of ether extract (from spleen of Case V.) in 0·2 c.c. of water. Symptoms appeared in about 10 minutes and were shown by irregular breathing, at times hurried and at times laboured, and a ruffling of the fur. This lasted for nearly two hours, during which period touching the animal produced general spasm of the muscles. The animal became very weak, and it died during the night. The post-mortem examination revealed no naked-eye change in the organs.

A second mouse, weighing 26 grammes, received subcutaneously 0·111 gramme of ether extract (from spleen of Case II.). It showed the same symptoms as the first mouse, with the exception that no spasms were produced by touching or pinching. The animal was weak but recovered the next day.

Another experiment was performed on mice with the ether extract from the spleen of Case V. The amount given was not weighed, but a small quantity was subcutaneously injected into two of these animals. Both were affected in from half-an-hour to an hour after the injection; they became very weak but showed no spasms of muscles while under observation. They both died during the night, and the only feature of the post-mortem was the well-marked rigor mortis; both animals showed well-marked curvation of the back and the tail was extended. The animal which received the largest dose showed a greater curvation of the back than the other.

It is quite clear, therefore, that the chief toxic substance (or substances) in the tissues in tetanus is contained in the ether extract. The ether precipitate is, even in large doses, not toxic. The ether extract as obtained is evidently a mixture; but it contains a body (or bodies) which is toxic, and which produces either tetanic spasms of the muscles generally, or a general weakness ending in death. The separation of these toxic substances is now occupying my attention.

General Conclusions.

As far as the investigation has proceeded, the results show:—

1. That in all cases of traumatic tetanus, there are present, in the spleen and in the blood, the products of bacterial action, viz., albumoses and certain acid organic bodies.
2. That to the albumoses must be ascribed the production of the fever of tetanus; they produce no tetanic convulsions.
3. That the ether extract contains the substances which are the direct excitants of the muscular spasms in tetanus.

No. 6.

A Note on Influenza Colds; by Edmund Cautley, M.D.

In view of the fact that a definite microbe is associated with Epidemic Influenza, and of the circumstance that, clinically, it is not always possible to distinguish true Influenza from severe "cold," the question has arisen whether in ordinary "cold" (febrile nasal and naso-pharyngeal catarrh, extending frequently to the bronchi) the Influenza microbe is or is not present in the secretions of the implicated mucous membrane. Accordingly I have made bacteriological examination of the nasal secretion of individuals thus affected.

It is a well-established fact that some of these cases of nasal and naso-pharyngeal catarrh are distinctly infectious; so much so, that when one member of a household is affected every other person, living in the same house, is apt to take the disease in similar or in modified form. This being the case, it is reasonable to infer that the *fons et origo mali* is some kind of micro-organism. But it by no means follows that the same micro-organism is the cause in every series of cases.

As bacteria are constantly present in the air, they are of necessity deposited on the moist nasal mucous membrane during inspiration. In culture experiments by Von Besser, by Wright (New York Medical Journal,, July 1889), and by others, a variety of bacteria and cocci were frequently obtained from normal nasal secretion.

Von Besser (Beiträge zur Path. Anat. Bd. VI., pp. 346 *et seq.*, and Centralb. für Bacteriol, vol. V., No. 21, 1889) examined such normal secretion in 81 cases, and he found micrococcus liquefaciens albus in 22; staphylococcus pyogenes aureus in 14; bacillus striatus albus in 10; streptococcus pyogenes in 7; micrococcus albus in 9; micrococcus flavus liquefaciens in 3; Friedlander's bacillus in 2; and diplococcus pneumoniæ in 3. In 11 cases no organisms were obtained by cultivation.

Paulsen (Centralb. für Bacteriol. Bd. viij., 1890, p. 344) examined 38 such cases making 64 cultures from them, with the following results:—

11	culture tubes	remained	sterile.
19	„	„	contained 10 colonies or less.
16	„	„	„ 100 colonies or less.
12	„	„	„ more than 100 colonies.
6	„	„	„ an uncountable number.

He found that cocci were more numerous than bacilli; that many liquefying cocci were present; but that none were absolutely identical with pus cocci. In eight cases a "sulphur yellow coccus" in tetrads was present.

On the other hand in acute nasal catarrh Paulsen found staphylococcus pyogenes aureus in seven cases out of 24, and E. Fränkel in two out of four. Various other organisms have been found, and described by different observers, in the nasal secretion of acute catarrh. Hajek (Berliner Klin. Wochenschr. 1888, No. 33) described a micrococcus

nasalis and a diplococcus coryzæ. Klamann (Allgmeine Medizin. Central Zeitung, 1885, pp. 1344–1347) describes a micrococcus fœtidus and diplococcus fluorescens fœtidus in cases of ozœna. In similar cases Hajek. (Münchener med. Wochenschr, 1887, No. 47) found the bacillus fœtidus ozœnæ, and Riemann (Inaug. Diss., Würzburg, 1887) described the bacillus smarajdinus fœtidus.

It is, therefore, evident that numerous organisms are present in nasal secretion, both in healthy and diseased conditions.

Passing now to my own observations, the clinical features of the cases examined consisted of febrile attack of varying severity, with congestion of the nasal mucous membrane. The congestion generally extended to the mucous membrane of the sinuses in connexion with the nose; often it extended to the posterior nares and pharynx. As a result of the congestion and of the consequent obstruction, there was often a feeling of stuffiness with frontal headache. A variable degree of lassitude and general malaise was present. At first the nasal secretion was absent or scanty and viscid; in two or three days it became more profuse and mucoid in character; later on it was muco-purulent. Duration of attack varied from a week to a fortnight.

Several difficulties were encountered in investigating the bacteriology of these cases.

First and chief was the difficulty of getting into relation with the sufferer in the early stages of his attack; at a time that is when the affection though not long established was affording sufficient nasal discharge for the purpose of making cultivations. Men rarely come under treatment for such attacks.

Secondly, in the later stages of the disease, when the nasal discharge is muco-purulent, many organisms of secondary importance are present.

Thirdly, the nasal mucous membrane, even when healthy, contains numerous micro-organisms; and these are likely to be still present when acute catarrh begins.

Ten cases have been examined by me in the following manner, at periods varying from one to five days from the onset of the symptoms. In each instance the nasal secretion was blown from the nostril of the patient into a sterilised watch glass, and a trace of the material was rubbed over the surface of agar-agar and gelatine plates. Subcultures on various media were then made from any colonies appearing in the plate cultures.

The most typical case examined, and one which presented the least liability to error, is the following:—

Case I, *Male*, 34.—"Cold" commenced on September 29th, with much sneezing and with a little febrile disturbance. It was worse the next day and the catarrh had by then extended back into the naso-pharynx. Total duration, one week.

Cultures were made from the nasal secretion, scanty though it was, on the first and second days of the attack. As regards the first day material:—An agar-agar plate at 37° C. showed in 24 hours between

70 and 80 small round white colonies. Two days later the larger of these colonies were rounded, with a well-defined border, and had a distinct yellowish tinge. The smaller colonies had also a yellowish tinge and paler peripheral portion.

Subcultures made on *gelatine* showed, in 24 hours, a scanty growth of minute whitish round colonies along the line of inoculation. The growth resembled that of a streptococcus. Gradually the colonies enlarged and became white. Liquefaction of the gelatine began in seven days and increased very slowly, the gelatine not being completely liquefied until the end of three weeks.

Subculture on *agar-agar* at 37° C. showed, in 24 hours, a thick white raised growth with moderate deposit in the condensation fluid.

Broth at 37° C. became turbid throughout at the end of two days and contained a moderate deposit. This deposit remained scanty and became rather tenacious.

Microscopically, the microbe was found to be a small non-mobile staphylococcus.

The plate cultures made on the second day of the illness yielded colonies of the same organism in even greater profusion. In addition there were five colonies of moulds and one of staphylococcus albus.

In the particular case, therefore, the only organism obtained by culture, which could be thought of as perhaps the cause of the attack, was a staphylococcus with a fairly characteristic growth on gelatine.

But there are three objections which may be urged against it being the causal factor.

Firstly, It was not obtained by culture, except doubtfully in one, in the other nine cases examined.

Secondly, a staphylococcus apparently identical in its cultural and microscopical characters is sometimes obtained as a skin contamination.

Thirdly, free inoculation with the microbe of the nasal passages of an adult male, twice repeated, produced no result.

Case II.—The only other case in which the nasal secretion of acute catarrh contained any organism in anything like pure culture, was that of a man aged 27. Nasal secretion was obtained on the 4th day of his attack, and consisted of a profuse mucoid discharge with a little muco-pus.

A microbe in almost pure culture was obtained on an agar-agar plate at 37° C. It consisted of small whitish colonies, with darker centre and irregular crenate edges. On *gelatine* subcultures minute round whitish isolated colonies were formed in 24 hours along the line of inoculation. On subculture on *agar-agar* at 37° C., the colonies presented the same appearances as in the original culture but were rather smaller.

Microscopically, the organism proved a streptococcus.

Three colonies of a small staphylococcus were also obtained from this case. Its cultural characters were similar to those of the staphylococcus in Case I.; but it differed in that it grew more freely in broth and liquefied gelatine more rapidly.

App. B. No. 6. Dr. Isambert Case of Dr. Cassidy.

As regards the other eight cases of catarrh examined by me, the results were practically negative. They were all examined at a period of three to five days from the onset of the "cold," and in each case the discharge consisted of mucus and a little muco-pus. I give the results of one as illustrative of the series, and as showing how many and how various were the organisms obtained.

Case III.—Male 28.—History of coryza for three days: much running from the nose and feverishness. The discharge consisted of mucus and a little muco-pus.

Gelatine Plate yielded:—

1. Seven colonies of aspergillus and penicillium.
2. Two moulds forming a brown growth on gelatine and not liquefying that medium.
3. One colony of sarcina lutea.
4. Four colonies of staphylococcus growing feebly on gelatine but not liquefying it.

Agar-agar Plate at 37° C. yielded:—

1. Two moulds.
2. Three colonies of staphylococcus aureus.
3. Two colonies of sarcina lutea.

No. 7.

The Micro-Organisms found in the Bronchial Glands; by Edmund Cautley, M.D.

An important channel whereby micro-organisms can enter the system is the respiratory tract. The absorption of pathogenic micro-organisms from the interior surface of the healthy respiratory tract is a well-established fact, since direct experiment has shown that inhalation of anthrax spores will produce systemic infection, and that inhalation of dried tubercular sputum will give rise to general tuberculosis Infection by this means is unlikely to take place through the thick mucous membrane, if healthy, of the nasal passages, trachea, and bronchi; it is much more likely to take place through the thin-walled air vesicles. With a view to ascertaining which of the numerous bacteria normally getting access to the respiratory tract are able to pass into the lymph stream, *i.e.*, into the lymphatic glands, the following investigations have been carried out.

With reference to tubercle bacilli, Pizzini (Rif. Med., Oct. 1891) has described the results of inoculations of guinea-pigs, made with material from the bronchial glands of a number of persons who had died from acute illnesses, or by accident. Although the glands had appeared microscopically, in every case, healthy, and though the body in no case showed signs of tuberculosis, he obtained the following results:—Out of 30 cases examined, 11 (dead of cerebral hæmorrhage, cardiac syncope, acute phosphorus poisoning, suicidal strangulation, suicidal gun-shot injury, fracture of the base of the skull, or by falls from scaffolding) had bronchial glands capable of infecting guinea-pigs with tuberculosis. And he argues that since 37 per cent. of these healthy persons, living in the open air and having no special dealings with phthisical patients, possessed bronchial glands which contained living infective tubercle bacilli, the tubercle bacillus is far more commonly distributed than is supposed. These observations would have been of very much more value if microscopical examination of these persons' bronchial glands had been made and had revealed the presence of the bacilli; considering the susceptibility of guinea-pigs to tuberculosis, the evidence hardly suffices to establish Pizzini's contention.

I myself have examined the bronchial glands in 25 cases.* In some of the 25, death was accidental or was due to acute disease; in the others the fatal disease was rather more prolonged.

The bronchial glands were obtained by me as soon as possible after death; placed for a few seconds in a saturated solution of perchloride of mercury to destroy any surface contaminations; then dried with sterile filter paper, and opened by an incision with a sterilized knife. Three gelatine and three agar-agar cultivations were in each instance

* As regards 20 of these cases (namely, all except Nos. 7, 12, 13, 18, and 19), examination of the Mesentric Glands was also undertaken, account of which will be found in the next succeeding paper of this volume.

made from the gland juice, well rubbed over the surface; the former were incubated at a temperature of 22° C., and the latter at a temperature of 37° C. Four cover-glass preparations were also in each instance made from the gland juice, and microscopically examined for tubercle bacilli. Of these, two were dried in the flame and stained in Weigert's methyl blue; the other two were, after drying, stained in hot carbol fuchsin, decolourised in 33 per cent. nitric acid, washed in tap water and in distilled water, and then counter-stained in methyl blue. In those instances where colonies developed on the culture media, sub-cultures were made on gelatine, agar-agar, and on various other media, and the microscopical and cultural characters of the several organisms thus obtained were duly examined.

Case 1. *Male*, 6.—Diphtheria of fauces and larynx. Glands of medium size. No organisms found in cover-glass preparations.

Case 2. *Male*, 4.—Laryngeal diphtheria. Glands small. Four pairs of small, stumpy bacilli found in one out of the four cover-glass preparations.

Case 3. *Male*, 20.—Ruptured liver, due to a railway accident. Glands large. A few diplococci found.

Case 4. *Male*, 69.—Cerebral hæmorrhage. Glands small. No organisms.

Case 5. *Male*, 4.—Otitis media and pyæmia. Glands small, and contained no organisms.

Case 6. *Female*, 5 *months*.—Marasmus. Glands of medium size. No organisms found, except one rod-shaped bacillus.

Case 7. *Male*, 47.—Brought into hospital dead; Angina pectoris. Glands large. No organisms.

Case 8. *Male*, 75.—Brought into hospital dead; Cerebral hæmorrhage. Glands of moderate size. No organisms.

Case 9. *Female*, 25.—Hæmatemesis. Glands rather large. No organisms.

Case 10. *Male*, 2.—Tubercular meningitis. Glands not enlarged, and contained no organisms.

Case 11. *Female*, 23.—Morbus cordis. Glands a little large. One long rod seen in cover-glass preparation.

Case 12. *Male*, 14.—Accident; fractured skull. Glands of medium size. No organisms.

Case 13. *Male*, 27.—Accident; run over by a cart. Glands small. A few cocci found.

Case 14. *Female*, 6.—Diphtheria of larynx. Glands large. No organisms.

Case 15. *Male*, 30.—Morbus cordis. Glands medium size. No organisms.

In 10 out of these 15 cases no organisms at all were found in the cover-glass preparations; in two cases only a single bacillus was found; in the other three a moderate number of microbes were seen. In none of the 15 cases was a single colony developed on gelatine at a temperature of 20° C. or on agar-agar at a temperature of 37° C. In other words, the bronchial glands, in 15 cases out of 25 examined, were sterile. It is especially noteworthy, that some of the above specimens were from cases, such as diphtheria and pyæmia, in which it would not have been surprising had their bronchial glands contained many organisms.

Case 16. *Female*, 40.—Pernicious anæmia. Glands of medium size. No organisms found in cover-glass preparations.

Agar-agar cultures yielded no growth. On one of the gelatine cultures a single minute transparent colony developed. Sub-cultures were made from this, as follows :—

Gelatine.—In 24 hours, numerous minute colonies.

Agar-agar.—In 24 hours, minute colonies on the surface, and scanty deposit in the condensation fluid.

Broth.—At 37° C. became turbid, and a scanty deposit settled.

Microscopically, the organism growing in these cultures proved to be a streptococcus.

Case 17. *Female*, 12.—Morbus cordis. Glands large and engorged with blood. Cover-glass specimens showed a few large rods with square cut ends; others in groups of four or five and a little curved. Also a few cocci.

Cultures proved sterile save for one small colony in one of the agar-agar tubes. Sub-cultures on gelatine, agar, and in broth afforded streptococci which presented the same mode of growth as, and microscopically were identical with, those of case No. 16.

Case 18. *Female*, 47.—Emphysema and dilated heart. Glands large and engorged with blood. A few cocci seen in cover-glass preparations.

All cultures were sterile except one on agar-agar. Two colonies of a coccus developed here, and, on making sub-cultures, the organism proved to be staphylococcus pyogenes citreus.

Case 19. *Male*, 6.—Diphtheria of fauces and larynx. Glands much enlarged. Cover-glass preparations showed a fair number of cocci arranged as diplococci; capsules appeared to be present, but were ill-defined.

Cultures on agar-agar at 37° C. and gelatine cultures at 22° C. afforded abundance of minute colonies. A few larger white colonies were also developed, which proved on sub-culture to consist of bacillus coli. Milk inoculated from a gelatine culture of these larger colonies was coagulated in two days, and broth cultures gave a marked indol reaction.

Sub-cultures from the smaller minute colonies were set going, and presented the following characteristics :—

Gelatine.—Minute transparent colonies in two days.

Agar-agar—Minute clear colonies, shreddy deposit in condensation fluid.

Broth became turbid in 24 hours.

Microscopically, this organism proved a coccus, chiefly in the form of diplococci. Result therefore as to Case No. 19.—Diplococcus pneumoniæ and bacillus coli.

Case 20. *Male*, 16.—Pernicious anæmia. Glands large. No organisms found in cover-glass preparations.

Cultivations yielded three kinds of organisms. *First:* Several small colonies, becoming gradually larger until reaching 4 or 5 mm. in diameter, having greyish centre and clear processes with rounded ends. Sub-cultures on agar-agar at 37° C. afforded minute colonies with shreddy deposit in the condensation fluid. Similar colonies were obtained in cultures from the mesenteric glands in the same case. Microscopically the microbe proved a streptococcus; possibly the streptococcus brevis of Von Lingelsheim. *Secondly:* Two white colonies developed rapidly on gelatine, and soon caused liquefaction of the medium. These, on further culture and on microscopical examination, proved to be proteus vulgaris. *Thirdly:* A single colony, forming a thick whitish growth on gelatine sub-culture, but not causing liquefaction of the medium, was also obtained. Microscopically this colony consisted of short mobile bacilli.

Result as to Case No. 20,—Streptococcus brevis, proteus vulgaris, and a short bacillus.

Case 21. *Male*, 2.—Tubercular meningitis. Glands large, and some of them caseous. Tubercle bacilli found in cover-glass preparations; also minute cocci arranged as diplococci and as short chains. A few larger cocci, as diplococci. One long rod-shaped bacillus. The cultures of the material on gelatine and on agar-agar afforded almost pure cultures of colonies which proved to be streptococcus pyogenes.

Several colonies of staphylococcus pyogenes aureus also developed, and one colony of bacillus coli.

Result as to Case No. 21,—Streptococcus pyogenes, staphylococcus aureus, and bacillus coli.

Case 22. *Male*, 41.—Hæmoptysis. Glands enlarged; a few cocci found in cover-glass preparations, and two tubercle bacilli.

In three days gelatine cultures contained numerous round, small, white colonies. These in a few more days increased in size to about 2 mm. diameter; were white, circular, and raised. Sub-cultures on gelatine formed small, white, round colonies in 24 hours. On agar-agar the colonies developed more freely at a temperature of 37° C. Broth became turbid in 24 hours. Microscopically the organisms proved a variety of streptococcus. It differs from the streptococcus pyogenes in growing much more freely, and in forming larger white colonies. It might be called streptococcus albus. Agar-agar cultures also yielded several colonies of the same organism.

In addition, there were developed on the original agar-agar cultures several minute colonies, like those of streptococcus pyogenes. On gelatine and agar sub-culture they resembled this latter organism in mode of growth. Broth inoculated with the gland juice became faintly turbid, and contained a moderate deposit. Microscopically however, these sub-cultures consisted of delicate bacilli, showing bipolar staining. Two colonies of a form of bacillus coli were also found. Milk was coagulated thereby in three days, when inoculated from gelatine sub-cultures.

Result as to Case No. 22.—Streptococcus albus, a bipolar bacillus, and bacillus coli.

Case 23. *Male*, 71.—Cerebral hæmorrhage. Glands large. In one cover-glass preparation a group of cocci was found.

Several organisms were obtained by cultivation. Three colonies of bacillus coli, and two colonies of a streptococcus rapidly liquefying gelatine. Streak cultures of the latter on gelatine showed liquefaction along the line of inoculation at the end of 24 hours; and stab cultures in gelatine show well-marked tubular liquefaction in two days, with a moderate, dense white, deposit: complete liquefaction occurred in six days. On agar-agar, at 37° C., there was in 24 hours a free growth of minute colonies, of almost the same colour as the culture medium, and a fair amount of deposit in the condensation fluid. Broth became densely cloudy in two days, and contained a moderate deposit. Microscopically, this organism also proved a streptococcus.

In addition, two colonies of a non-liquefying staphylococcus, one of diplococcus pneumoniæ, and one of streptococcus pyogenes, were also obtained from the glands in this case.

Case 24. *Male*, 49.—Cardiac failure. Glands of medium size. No organisms found in cover-glass preparations.

Several colonies of a staphylococcus developed on gelatine and on agar: their mode of growth was like that of a streptococcus, but their microscopical characters in agar-agar and broth culture showed them to be staphylococci.

Case 25. *Woman*, 65.—Dilated heart, secondary to emphysema. A few cocci arranged as diplococci were found in the cover-glass preparations.

Upon culture several colonies of bacillus coli, diplococcus pneumoniæ, and streptococcus pyogenes were obtained. Also one colony of proteus vulgaris, and one of a chromogenic bacillus.

Analysis of these other 10 cases gives the following results:—

I. *Staphylococci*:—

A. Liquefying—

1. Staphylococcus pyogenes citreus in one case.
2. Staphylococcus pyogenes aureus in one case.

B. Non-liquefying—

1. A variety of staphylococcus growing freely on gelatine, but not very freely on agar-agar, in one case.
2. A staphylococcus resembling a streptococcus in its mode of growth, in one case (No. 24).

Except this last, the staphylococci obtained were only present in cultures to the extent of two or three colonies.

II. *Streptococci*:—

1. Streptococcus pyogenes was present in five cases; never more than two or three colonies.
2. Streptococcus brevis, in one case.
3. Streptococcus albus, in one case.
4. Streptococcus liquefaciens, in one case (No. 23).

III. *Diplococcus Pneumoniæ*, in three cases.

IV. *Bacilli*:—

1. Bacillus coli communis, in five cases.
2. Proteus vulgaris, in two cases.
3. Three other varieties of bacillus, none numerous, in three cases (Nos. 20, 22, 25).

It is a notable fact that bacillus coli was present in the bronchial glands in five out of 10 cases in which organisms were found, whereas it was not, as will be seen from my other paper in this volume, nearly as often present in cultures from the mesenteric glands.

A large number (from 17 or 18 cases) of specimens were examined for tubercle bacilli; but, as has been seen, they were only found in two instances, and in these two cases there were caseous glands in the neighbourhood.

The bronchial glands, therefore, were never found crowded with organisms; and this notwithstanding that in making the cultivations therefrom the surface of gelatine and agar-agar was freely smeared with gland juice undiluted. In every case the colonies were, as matter of first instance, sufficiently isolated for the purpose of making sub-cultures.

Conclusions :—

1. The bronchial glands contain organisms of various kinds in certain cases.
2. Organisms are present both in health and disease.
3. Oganisms are absent both in health and disease.
4. The organisms present are not necessarily living.
5. Organisms are not present in large numbers.
6. The bacillus of tubercle is not commonly present.

No. 8

On Micro-Organisms found in the Mesenteric Glands; by Edmund Cautley, M.D.

As regards the absorption of micro-organisms from the interior of the healthy intestine, the only channels for their passage, leaving out of account localised penetration of and growth through the mucous membrane (as, for instance, in ulceration), are the blood vessels and the lymphatics.

As to absorption of microbes by the blood vessels of the intestines, little, however, is known, the evidence in regard of infections received by way of the alimentary tract pointing in the main to absorption of their particulate causes by the lymphatics; as for instance in milk scarlatina, in milk typhoid, and in intestinal tuberculosis.

It is therefore interesting to ascertain which of the numerous bacteria inhabiting the alimentary canal can pass into the lymph stream, *i.e.*, into the mesenteric glands.

Three questions naturally arise here, namely:—

1. Are organisms present in the mesenteric glands?
2. If organisms are present there, are they living?
3. If living organisms are present, what varieties are commonly found?

In order to investigate these points, the mesenteric glands were taken from the bodies of various persons, 25 in number,* who died in the hospital. As far as possible, the cases selected were those of persons who had died from accident or from disease in which there was no suggestion of septicæmic infection. No case was examined if there were definite signs of decomposition; and care was exercised not to take mesenteric glands from cases in which the small intestine presented to the naked eye any sign of disease.

The method of investigation consisted in removing the glands from the body, placing them in a saturated solution of perchloride of mercury for a few seconds in order to destroy any surface contaminations, and drying them on sterilized filter paper. They were then opened with a sterilized knife, and three gelatine and three agar-agar cultures were inoculated with the gland juice, freely smeared over the surface. The gelatine cultures were incubated at 20° C., and the agar-agar cultures at 37° C. Sub-cultures were made from any colonies which grew on these or on certain other nutrient media which were also employed. Four coverglass preparations were also made from the fresh gland juice dried over the flame, and stained in various aniline dyes.

Case 1. *Male*, 71.—Cerebral hæmorrhage.

Case 2. *Male*, 75.—Meningeal hæmorrhage.

Case 3. *Male*, 69.—Cerebral hæmorrhage.

In these three cases the glands were small. No organisms were found in stained coverglass preparations of the fresh gland-juice, and none were obtained by cultivation on gelatine or on agar-agar.

* The bronchial glands of all 25, except Nos. 4, 9, 17, 18, and 22, were also examined; account of this examination is given in the preceding paper.

Case 4. *Male*, 47.—Cerebral hæmorrhage. Coverglass preparations crowded with cocci; cultures sterile.

Case 5. *Male*, 41.—Hæmorrhage from the lungs, due to phthisis. Glands of medium size; no organisms found.

Case 6. *Male*, 30.—Cardiac failure, secondary to morbus cordis. Glands of medium size; no organisms found.

Case 7. *Female*, 12.—Cardiac failure, secondary to mitral stenosis. Glands of medium size. A few long rods found in coverglass preparations, but no organisms obtained by cultivation.

Case 8. *Female*, 25.—Hæmatemesis. Glands small. Cultures sterile; many cocci, isolated and in groups, found in coverglass preparations.

Case 9. *Male*, 16.—Fractured skull. Glands of medium size; no organisms found.

Case 10. *Female*, 6.—Laryngeal diphtheria. Glands small; few cocci found in coverglass preparations; no growth on culture media.

Case 11. *Male*, 4.—Laryngeal diphtheria. Glands large; no organisms found.

Case 12. *Male*, 2.—Tubercular meningitis. Glands large. Many cocci, one large rod-shaped bacillus and one small bacillus, found in coverglass preparations. Cultures sterile.

Case 13. *Male*, $1\frac{3}{4}$.—Tubercular meningitis. Glands large. A few cocci, arranged in chains, found in coverglass preparations. Cultures sterile.

Case 14. *Male*, 4.—Double otitis media. Glands large. No organisms found.

Case 15. *Female*, 5 *months*.—Marasmus. Glands of medium size. No organisms found.

In these 15 cases no organisms were obtained from the glands on cultivation by means of the methods above described. In nine out of the 15 no organisms were found in the coverglass preparations. In the remaining six, organisms were found in coverglass preparations, numerous in two of the five.

In the next succeeding 10 cases, various organisms were obtained by cultivation on gelatine at 20° C. or on agar-agar at 37° C. In some of these other 10 cases, organisms were detected in the coverglass preparations; in some they were not.

Case 16. *Female*, 40.—Pernicious anaemia. Glands large and hæmorrhagic. Nothing found in coverglass preparations. All the culture tubes proved sterile, with the exception of one gelatine tube in which there was a single minute colony. Subcultures from this on gelatine, agar-agar, and in broth showed the organism of this colony to be streptococcus pyogenes.

Case 17. *Male,* 3.—Laryngeal and faucial diphtheria. Glands large. Only a single colony appeared in one of the six culture tubes inoculated. Microscopically this proved to be a very minute staphylococcus. As to its cultural characters: on gelatine it formed a delicate filmy growth of minute colonies: on agar-agar at 37° C. a fairly definite growth appeared along the line of inoculation and considerable deposit formed in the water of condensation.

Case 18. *Male,* 42.—Fractured skull. Glands of medium size. No organisms found in coverglass preparations. By cultivation there were obtained:—

(1.) One colony of bacillus coli.

(2.) Three colonies of staphylococcus aureus.

Case 19. *Male,* 49.—Cardiac failure, secondary to emphysema. Glands very small. A few cocci found in coverglass preparations, and several colonies of streptococcus pyogenes obtained by culture.

Case 20. *Female,* 23.—Cardiac failure, secondary to morbus cordis. Glands small. No organisms found in coverglass preparations. By culture only three colonies in all were obtained, and these developed in one of the gelatine cultures. Two out of the three liquefied gelatine, and on subculture gave results as follows:—

On *gelatine.*—In two days considerable liquefaction along the line of inoculation, and yellow deposit formed; the gelatine almost completely liquefied in nine days.

On *agar-agar* at 37° C.—Scanty growth in four days, with yellowish tinge in growth, and deposit in the condensation fluid.

Broth at 37° C.—At the end of 24 hours the medium was turbid and contained a moderate deposit. In four days the deposit was well marked and pale yellow in colour.

Microscopically, the organism proved a minute coccus forming zooglœa and short chains.

The third colony yielded a well-defined, raised, but not extensive growth on gelatine; a thicker and more extensive growth on agar-agar. Broth became turbid and contained a moderate deposit. Gelatine not liquefied. Microscopically, this was a staphylococcus.

Result as regards *Case* 20.—Two colonies of staphylococcus pyogenes citreus; one colony of a non-liquefying staphylococcus albus.

Case 21. *Female,* 65. Cardiac failure, secondary to emphysema. Glands small. No organisms seen in coverglass preparations. Both agar-agar cultures, at 37° C., and gelatine cultures, at 20° C., yielded one and the same organism in fairly large number. Characters on subculture:—

On *gelatine:* in three days minute colonies along the line of inoculation.

On *agar-agar:* minute whitish, almost transparent, colonies; scanty deposit in the condensation fluid.

Broth, became faintly turbid in two days and contained only a trace of deposit.

Microscopically, this was a long rod-shaped bacillus, with square cut ends, growing into chains and threads.

Case 22. *Female*, 52. Cardiac failure, secondary to emphysema. Patient died 24 hours after admission to the hospital. Her temperature was 101° F. Glands large. Culture on :—

Agar-agar at 37° C. showed in three days several minute colonies like those of streptococcus pyogenes. No growth developed on *gelatine*.

Subcultures in *Broth* contained in two days a white deposit, fluffy and flocculent; shaken slightly, the deposit floated in the form of small woolly masses. The supernatant broth remained clear.

Microscopically, the organism was a bi-polar short bacillus, growing into long threads, namely, the influenza bacillus.

Case 23. *Male*, 6.—Diphtheria of larynx. Glands large. Cover-glass preparations showed many short, stumpy rods. *Gelatine* cultures of the material yielded several colonies of apparently two kinds. One variety present in considerable number proved on subculture to be the bacillus coli communis. It grew in the usual way upon gelatine and agar-agar; formed gas bubbles quickly and profusely in gelatine-agar-agar, and glycerine-agar shake cultures; coagulated milk in 24 hours; and gave a marked indol reaction when grown in broth. The other variety at the end of two days had in the original gelatine cultures developed in the form of minute round white colonies. By transmitted light, under a low magnifying power, each colony was round, oval, or kidney-shaped, and brown in colour. Subcultures on *gelatine* formed, in 24 hours, a moderate growth of minute round white colonies along the line of inoculation. Gradually the colonies, after growing a little larger, assumed a delicate yellow hue, and the gelatine slowly liquefied; complete liquefaction resulted in three to four weeks. On *agar-agar* a moderate pale-yellow growth developed. Microscopically, this is a coccus forming zoogloea. One colony of staphylococcus albus was also obtained.

The original *agar-agar* cultures of the gland juice yielded two colonies of bacillus coli and one of staphylococcus albus. In addition to these, many minute transparent colonies and scanty deposit in the condensation fluid were also observed. Subcultures from this on *gelatine* and broth gave no result, but subcultures on *agar-agar* gave results at 37° C. as in the primary culture. Microscopically the organism proved to be a long rod-shaped bacillus, forming long threads.

Result as regards *Case* 23,—Bacillus coli communis, staphylococcus pyogenes albus, a variety of staphylococcus pyogenes citreus, and a peculiar bacillus.

Case 24. *Male*, 16.—Pernicious anæmia. Glands large. Five cocci and one bacillus were found in the coverglass preparations. *Gelatine* cultures yielded one variety of organism, in pure culture, fairly profuse. It appeared as small transparent colonies, which developed in three days and slowly increased in size to about mm. diameter,

when the growth presented a greyish centre and more transparent peripheral portion; sending out processes with rounded ends. On *agar-agar* at 37° C. minute round white colonies appeared, and shreddy deposit in the condensation fluid developed in 24 hours. Subcultures in *broth* in 24 hours became moderately turbid and contained a scanty deposit. Microscopically, the organism is a coccus forming chains.

Result as regards *Case* 24,—A pure culture of a streptococcus; possibly the streptococcus brevis of Von Lingelsheim.

Case 25. *Male*, 20.—Ruptured liver. Glands small. No organisms found in coverglass preparations. From the gland juice there were by culture three varieties of staphylococcus:—

1. Staphylococcus pyogenes aureus.
2. A non-liquefying chromogenic staphylococcus, producing a narrow, delicate, yellow coloured growth on gelatine.
3. A single colony of a staphylococcus resembling staphylococcus albus, except that it did not liquefy gelatine.

Analysis of the above cases gives the following results. In 15 out of 25 cases no living organisms were found in the juice of the mesenteric glands. In six out of these 15, such organisms as were found were discovered in coverglass preparations only. In the remaining 10 cases, cultures of the gland juice produced colonies. In two of the 10 only a single colony in each instance was found in the six tubes inoculated with the gland juice; and in these two there were no organisms discoverable in the coverglass preparations.

The organisms found were the following, their number and variety being surprisingly small:—

Staphylococci:—

A. Liquefying gelatine.
   1. Staphylococcus pyogenes aureus in two cases.
   2. Staphylococcus citreus in one case.
   3. Staphylococcus; very like citreus in one case.
   4. Staphylococcus albus in one case.

B. Not liquefying gelatine.
   1. Staphylococcus, chromogenic, yellow, in one case.
   2. Staphylococcus, not chromogenic, in one case.
   3. Staphylococcus, growing somewhat like a streptococcus in one case.

Streptococci:—

1. Streptococcus pyogenes in two cases.
2. Streptococcus brevis of Von Lingelsheim (?) in one case.

Bacilli:—

1. Bacillus coli communis in two cases.
2. Influenza bacillus in one case.
3. Long rod-shaped bacillus, growing on gelatine in one case.
4. Long rod-shaped bacillus, not growing on gelatine in one case.

From the above observations it would appear that the mesenteric glands, whether in health (as in the cases of death from accident) or

in disease of various kinds, are not normally crowded with organisms. Very often indeed in these experiments the glands were found to contain no living organisms.

The conclusions I draw are as follows:—

Firstly. Organisms do reach the mesenteric glands, but not in large numbers.

Secondly. Many of those which reach these glands do not retain their vitality.

Thirdly. The organisms found by me in these glands are such as are commonly found in the alimentary canal.